Panasonic

KW9M
Eco-POWER METER
User's Manual

WUME-KW9M-01

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Cautions for Your Safety

Read the manual carefully before installing, running and maintenance for proper operation.

Before using, master the knowledge of the equipment, safety information and all of other notes.

This manual uses two safety flags to indicate different levels of danger.

⚠ WARNING A handling error could cause serious physical injury to an operator and in the worst case could even be fatal.

- Always take precautions to ensure the overall safety of your system, so that the whole system remains safe in the event of failure of this product or other external factor.
- Do not use this product in areas with inflammable gas. It could lead to an explosion.
- Exposing this product to excessive heat or open flames could cause damage to the lithium battery or other electronic parts.
- Do not open the secondary side of CT during power on the primary side current. It might cause electric shock or CT breakdown.

⚠ CAUTION A handling error could cause serious physical injury to an operator or damage to the equipment.

- To prevent abnormal exothermic heat or smoke generation, use this product at the values less than the maximum of the characteristics and performance that are assured in these specifications.
- Do not dismantle or remodel the product. It could lead to abnormal exothermic heat or smoke generation.
- Do not touch the terminal while turning on electricity. It could lead to an electric shock.
- Use the external devices to function the emergency stop and interlock circuit.
- Connect the wires or connectors securely. The loose connection might cause abnormal exothermic heat or smoke generation.
- Do not allow foreign matters such as liquid, flammable materials, metals to go into the inside of the product. It might cause exothermic heat or smoke generation.
- Do not undertake construction (such as connection and disconnection) while the power supply is on.
- Never remove the terminal block under applying current to load. It might cause electric shock or CT breakdown.
- Do not use at secondary side circuit of inverter. It might cause exothermic heat or damage.

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Introduction

Thank you very much indeed for purchasing “KW9M Eco-POWER METER”.
In this manual, we explain the usage of “KW9M Eco-POWER METER” in detail.
Please use it correctly after understanding the content enough.

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Cautions before using

■ About this product

Eco-POWE METER us designed chiefly to manage saving energy.
It is neither nor can it be legally used for billing.

■ Installation environment

◇Do not use the Unit in the following environments.

- ・Where the unit will be exposed to direct sunlight and where the ambient temperature is outside the range of -25 to 55 °C.
- ・Where the ambient humidity is outside the range of 30 to 85 % RH (at 20℃), non-condensing and where condensation might occur by sudden temperature changes
- ・Where inflammable or corrosive gas might be produced
- ・Where the unit will be exposed to excessive airborne dust or metal particles
- ・Where the unit will be exposed to water, oil or chemicals
- ・Where organic solvents such as benzene, paint thinner, alcohol, or strong alkaline solutions such as ammonia or caustic soda might adhere to the product
- ・Where direct vibration or shock might be transmitted to the product, and where water might wet the product
- ・Where the place near high-voltage cable, high-voltage device, power line, power device.
- ・Where the place near a machinery with transmission function such as amateur radio.
- ・Where the place near a machinery which occurs the big switching serge

◇Please use the Unit according to the specifications described in this manual. Otherwise, it may malfunction or cause fire and an electric shock.

- ・Connect to the power supply in compliance with the rating.
- ・Refer to the wiring diagram to ensure proper wiring for the power supply, input and output.
- ・Do not perform wiring or installation with a live line. It may also lead to circuit burnout or fire by way of the secondary CT side opening.

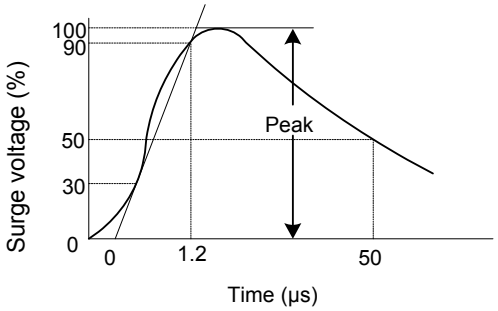
■ Installation

- ・Eco-POWER METER is designed to be used in a control panel.
- ・The power supply terminal and voltage input terminal of the main unit is common. Therefore if additional noise effects the power supply line, incorrect measurements may result.
- ・Installation and wiring must be performed by expert personnel for electrical work or electric piping.
- ・Never remove the terminal block under applying current to load.
  It might cause electric shock or CT breakdown.
- ・Do not add an excess power to the display. It might break the inner liquid crystal.
- ・Although the case is made from fireproof resin, do not mount it next to flammable materials. Also, avoid placing it directly on top of materials that catch fire easily.
- ・If the operating power supply surge exceeds the following value, the internal circuit could be destroyed, so be sure to use a surge absorption element.

Surge voltage	6,000V

Standard surge waveform
The above value is the surge-voltage resistance at ± (1.2/50) μs of single-polarity full-wave voltage.

Surge wave form
[± (1.2/50) μs single-polarity full-wave voltage]



・External noise up to the level shown below is treated as noise voltage, but levels higher than this could lead to malfunctioning or damage to the internal circuit. Although the case is made from fireproof resin, do not mount it next to flammable materials.

	Between operating power supply terminals
Noise voltage	1,500V

Noise wave form (noise simulator)
Rise time: Pulse width: 1 μs, 50 ns
Polarity: Cycle: 10 ms

Note) Accurate measurement may not be possible if excessive noise gets added to the input line.

・This product is designed to be used only with our options.
Options from other companies are not compatible.

■ As to measurement

・If there is some distortion by harmonic or waveform, it may not measure correctly.
Please check with the actual system before adopts it.
・It might not measure an instantaneous current such as an inrush current or an welding machine.
・When measuring the below loads, it might not satisfy with the accuracy guarantee.
Out of rating current, Load with low power factor,
Load with winding current, Load with ferromagnetic field
・Power factor operation is a method assuming balanced load. The error might be big when it measures unbalanced load.

■ Static electricity

・Discharge static electricity touching the grounded metal etc. when you touch the unit.
・Excessive static electricity might be generated especially in a dry place.

■ Cleaning

・Wipe dirt of the main unit with soft cloth etc. When thinner is used, the unit might deform or be discolored.

■ Power supply

・Connect a breaker to the voltage input part for safety reasons and to protect the device.
The breaker that connects to the voltage input part must arrange at the position easily reached, and display shows it is the breaker of the equipment.
・Do not turn on the power supply or input until all wiring is completed.

■ Before power on

Please note the following points when turning on power at the first time.
・Confirm there are neither wiring rubbish nor especially an electrical conduction when installed.
・Confirm neither the power supply wiring, the I/O wiring nor the power-supply voltage are wrong.
・Tighten the installation screw and the terminal screw surely.
・Use an electric wire applicable to the rated current.

■ Before change the setup

Set the password carefully.
In order to avoid unexpected change the settings, it can set password. However, if you forget the password you can’t change the settings.
We recommend you to note the password when you set and change the password.

Chapter 1 Unit's Outline

With KW9M Eco-POWER METER, electrical power (voltage, current, etc.), power factor, frequency, etc are measured using AC voltage and AC current input via one of the following systems: single-phase two-wire system, single-phase three-wire system, three-phase three-wire system or three-phase four-wire system.
This has built-in thermistor to measure the temperature of installation place such as inside the panel board for your reference.

■**Eco-POWER METER is designed chiefly to manage saving energy. It is neither intended nor can it be legally used for billing.**

Model number	AKW91110
Model name	KW9M Eco-POWER METER Standard type

1.1 Measurement outline

Phase/Wire system	Single-phase two-wire (1P2W) Single-phase three-wire (1P3W) Three-phase three wire (3P3W) Three-phase four-wire (3P4W) (common)
Applicable power system	100V system, 200V system, 400V system
Measurement circuit	1-circuit (when measuring 1P2W: max. 3-circuit)
Input measurement voltage	0 to 500VAC
Input measurement current	1 to 4000A
Applicable current sensor	Secondary side current: 1A or 5A

1.2 Measurement items

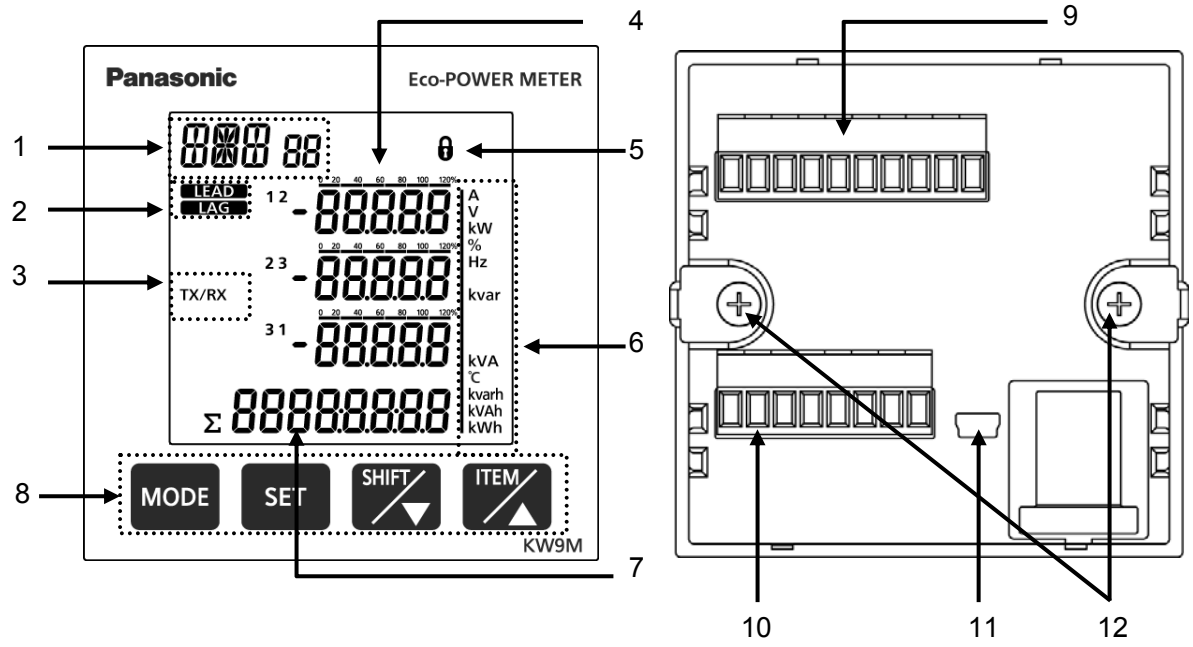
Item		Unit	Display data range
Integral power (import)	Active	kWh	0.000 to 9999999.9
	Reactive	kvarh	
	Apparent	kVAh	
Integral power (export)	Active	kWh	0.000 to 9999999.9
	Reactive	kvarh	
Instantaneous power	Active	kW	-99999 to 0.000 to 99999
	Reactive	kvar	
	Apparent	kVA	
Current		A	0.000 to 8000.0 *1
Voltage (phase / line)		V	0.00 to 99999 *1
Power factor			-1.000 to 0.000 to 1.000 (Fixed 3 places of decimal)
Frequency		Hz	0.00 to 99.99 *1 (Fixed 2 places of decimal)
Conversion value			0.000 to 9999999.9
Temperature		degree C	-100.0 to 0.0 to 100.0 *1 (Fixed 1 place of decimal)

*1 'Display data range' is the range to be able to indicate with the main unit display, it is not a range that can be measured.

Chapter 2 Parts Name and Working

2.1 Parts Names

<Front> <Back>



1	Item indicator	Measuring mode	Indicate the measuring item
		Setting mode	Indicate the setting item
2	Auxiliary mark	Measuring mode	Indicate the power condition *1
3	TX/RX mark	Measuring mode	Blinking while communication
4	Load ratio indicator	Measuring mode	Indicate the ratio of load (current) for the rating
5	Lock mark	Measuring mode	Lighting while in lock mode
6	Unit mark	Measuring mode	Indicate the measuring unit
7	Measurement value	Measuring mode	Indicate the measuring value
		Setting mode	Indicate the setting value
8	Keys	Use to operate the unit	
9	Terminal block A		
10	Terminal block B		
11	USB port	USB communication port	
12	Mounting clip	Use to panel mounting (screws:M4x10mm)	

*1 Auxiliary mark [LEAD] [LAG] indicates the phase difference between voltage and current.
When current phase delays to voltage phase, [LAG] is indicated.
When current phase leads to voltage phase, [LEAD] is indicated.
When power factor is ‘1’, ‘0’ and ‘-1’, it doesn’t display [LEAD] nor [LAG].

2.2 Key's functions

Key	Functions	
<MODE>	Measuring mode	Shift to setting mode
	Setting mode	Shift to setting confirmation mode and measuring mode
<SET>	Setting mode	Set setting items and setting values
<SET> (continuous 3-sec)	Measuring mode	All keys locked
	Lock mode	Release the lock mode
<SHIFT/▽> <ITEM/△>	Measuring mode	Select measuring item to display
	Setting mode	Select a setting value

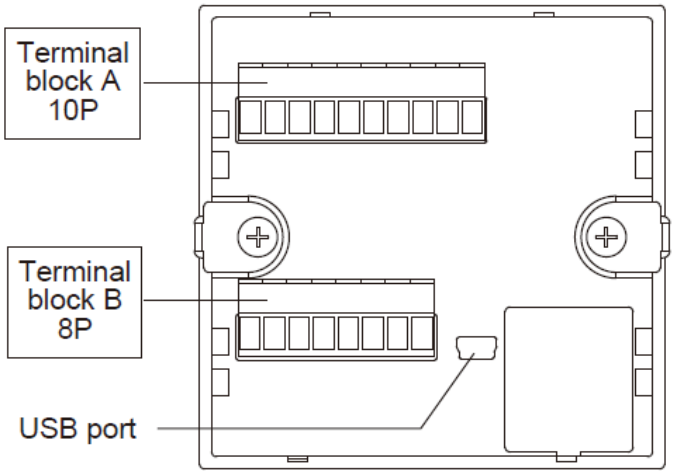
●Lock mode

It is the mode makes all keys unable. In this mode, you can not input by any keys.
When you press <SET> continuously for about 3sec., lock mark is displayed.
Press <SET> continuously for about 3sec. again to release Lock mode.
When it set to use auto-display functions, the display items are changed automatically.
Refer to 4.4.3 setting for optional functions for auto-display functions.

Chapter 3 Wiring

Be sure to wire correctly according to the terminal arrangement and wiring diagrams.
Please connect a fuse or a breaker to power supply part for safety reasons and to protect the device.
This has no built-in power switch, circuit breaker or fuse for measured voltage input parts.
Therefore it is necessary to install them in the circuit near this unit.
Do not turn on the power supply or input until all wiring is completed.

3.1 Main unit terminal arrangement



◆Common for terminal block A, B
Screw size: M2.5
Tightening torque: 0.4 to 0.5Nm
Applicable wire:
(Crimp-type terminal is recommended.)
・single wire 0.13 to 4mm^2 (AWG26 to 12)
・stranded wire 0.2 to 4mm^2 (AWG24 to 12)
・for 2 pcs.
single wire / stranded wire
2pcs.x0.13 to 2.1mm^2 (AWG26 to 14)
Stripping length: 6 to 7 mm

●Terminal block A (upper) 10P

Terminal number	1	2	3	4	5	6	7	8	9	10
Functions	L ＋	N －	V1	V2	V3	Vn	NC	SG	A ＋	B －
	AUX (Power supply)		Measured voltage input				vacant	RS485		

●Terminal block B (lower) 8P

Terminal number	1	2	3	4	5	6	7	8
Functions	K	L	K	L	K	L	NC	NC
	CT1		CT2		CT3			
	Measured current input						vacant	

⚠ **The input voltage to each terminal is as follows.**

Terminal	Phase and wire system	Terminal No.	Input voltage	
Power supply	Single-phase two-wire	1 - 2 (L+ - N－)	85-264V AC [85-264V ∿] 100-300V DC [100-300V ⎓]	
Measured voltage input	Single-phase two-wire	3 - 6 (V1-Vn)	0-500VAC [0-500V ∿]	(L-L)
	Single-phase three-wire	3 - 5 - 6 (V1-V3-Vn)	0-500VAC [0-500V ∿ :3W] 0-250VAC [0-250V ∿ :3W]	(L-L) (L-N)
	Three-phase three-wire	3 - 5 - 6 (V1-V3-Vn)	0-500VAC [0-500V 3 ∿]	(L-L)
	Three-phase four-wire	3 - 4 - 5 - 6 (V1-V2-V3-Vn)	0-500VAC [0-500V 3 ∿] 0-289VAC [0-289V 3N ∿]	(L-L) (L-N)

3.2 Wiring Diagrams

Please connect a breaker or a fuse to the power supply and voltage input part for safety reasons and to protect the device.

·Recommended breaker: 3 to 15A

·Recommended fuse : Time-lag fuse rated current 2A

Grounding the secondary side of VT (Voltage transformer) and CT (Current transformer) is not necessary with low-voltage circuit.

*When using several CTs, set each CT approximately 1m apart. If the two CTs are set too close each other, it may not measure accurately due to magnetic field interference.

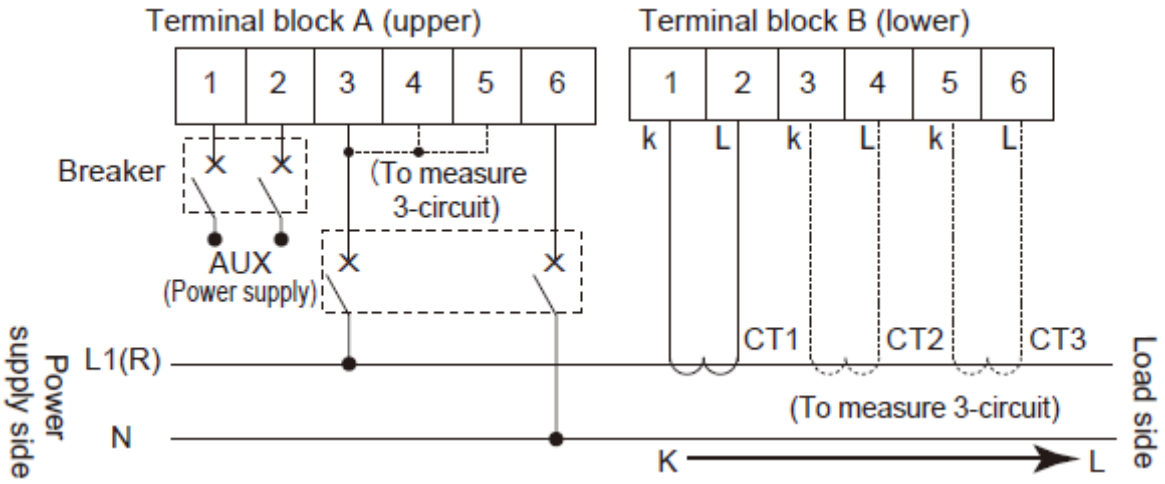
◆When measuring a load with rated input voltage

Single-phase two-wire system

*One CT is needed to measure single-phase two-wire system.

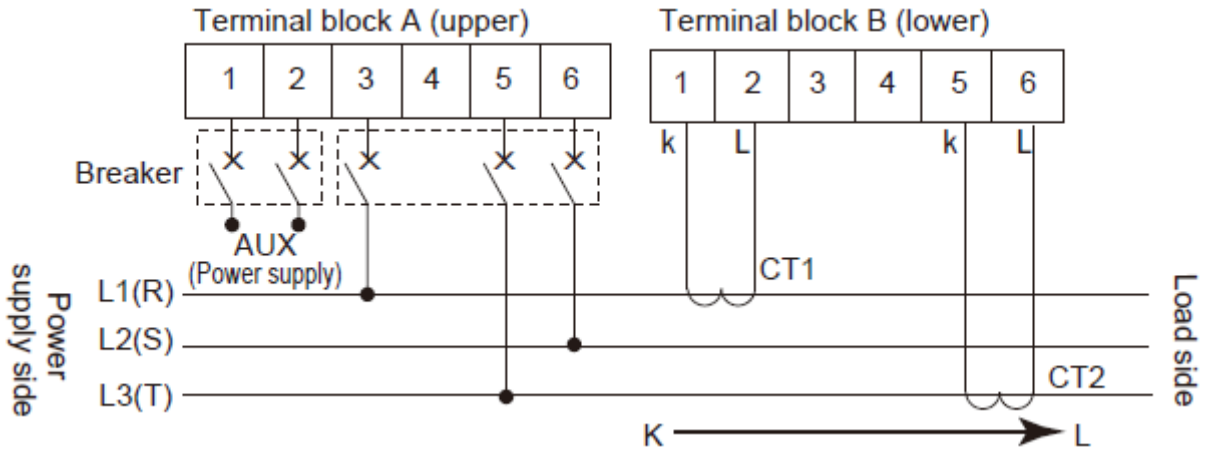
*2 CTs are needed to measure 2-circuit and 3 CTs are needed to measure 3-circuit.

*To measure 2-circuit, wire 3 and 4. To measure 3-circuit, wire 3 and 4 and 5.



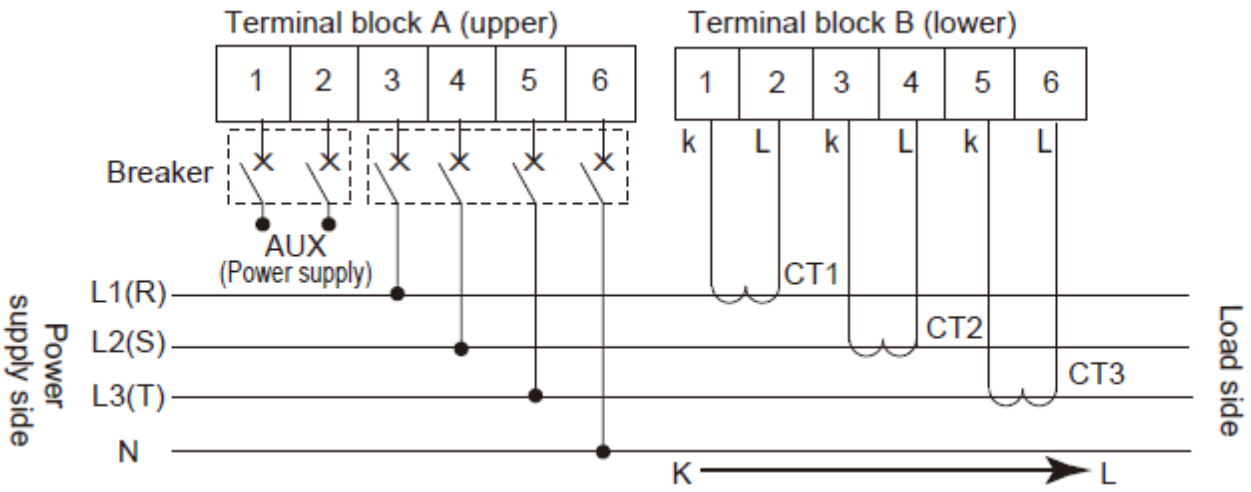
Single-phase three-wire/Three-phase three-wire

*2 CTs are needed to measure single-phase three-wire system, three-phase three-wire system.



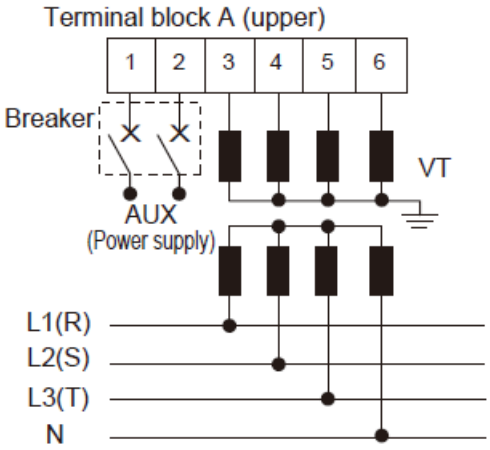
Three-phase four-wire system

*3 CTs are needed to measure three-phase four-wire system.



◆When measuring a load with exceed input voltage

Voltage transformer (VT) is needed when you measure a load with over input voltage.
Use a VT, those secondary voltage rating is 110V.
Grounding the secondary side of VT and CT is not necessary with low-voltage circuit.



3.3 How to attach the Current Transformer (CT)

DANGER

●Never open the secondary circuit of CT under applying current to load.

●Never remove the terminal block under applying current to load.

Will cause electric shock or breakdown CT

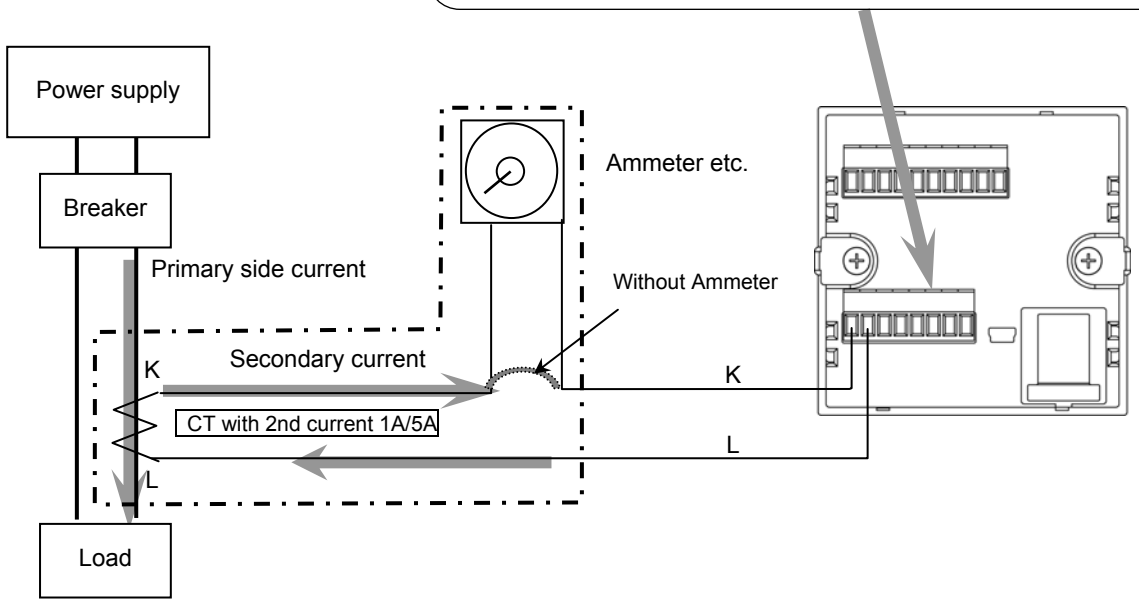
- Use CT that the secondary side current is 5A or 1A, the rated burden 0.5VA or more.
- One CT is needed for 1 unit when measuring 1P2W (2 CTs for 2-circuit, 3CTs for 3-circuit). Two CTs are needed when measuring 1P3W/3P3W. Three CTs are needed when measuring 3P4W. Using all CTs for one unit should be the same.
- Use the applicable wire, or it might cause a breakdown, burnout or electric shock.
- When connecting CT, connect the secondary side to the terminal of the main unit first, and after that wire the primary side to a load electric wire. Incorrect order might cause an electric shock or break CT.
- The CT has polarity. Wire correctly according to the K and L marks. **Wrong direction can't measure correctly.**
- If there is some distortion by harmonic or waveform, it may not measure correctly. Please check with the actual system before adopts it.
- Separate the wiring (strong electric part) of the measured voltage input terminal (operating power supply terminal) from the CT cable. It may not satisfy the accuracy due to noise.

◆How to connect CT

(1) Power off the measured devices.
(2) Install applicable CT.
(3) Remove terminal block of KW9M.
(4) Connect CT to the terminal block.
(5) Insert terminal stand surely.
(6) After confirm all wiring correct, turn on the power of the load and KW9M.

(Connection example)

* Connect CT wiring and terminal block surely.
  It will cause CT breakdown.
* Never remove the terminal block under applying current to load. It will cause electric shock or breakdown CT.



◆How to set the parameters for CT

(1) Select CT type (CT-T) according to the using CT.
  (Select '5A' if secondary side current of using CT is 5A. Select '1A' if secondary side current of using CT is 1A.)
(2) Set the primary current of measured CT at primary side current of CT setting mode (CT-1).
  < ex > If the measured CT is 400A/1A or 400A/5A, set to"400".
(3) Connect CT according to the CT direction, power side (K) to load side (L).

3.4 RS485 Communication

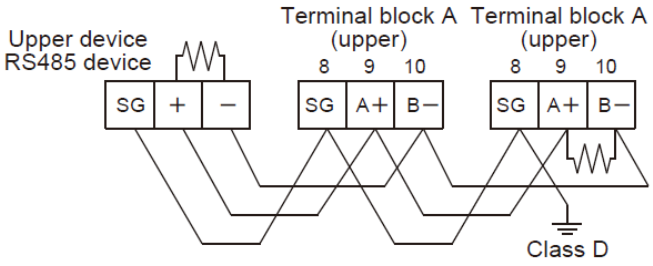
・When using shielded cable for the RS485 transmission line, ground one end.
Use a class D dedicated earth for grounding. Do not share a ground with other earth lines. (Fig. 1)

・For terminal stations of both side including the upper device, termination resistors should be connected. KW9M Eco-POWER METER doesn't have any built-in termination resistors.
Connect 120Ω, 1/2W or more termination resistor between [A+] and [B-] of Eco-POWER METER that is connected the end of RS485 transmission line. The RS485 transmission line shielded cable should be grounded at the end KW9M Eco-POWER METER. (Fig. 1)

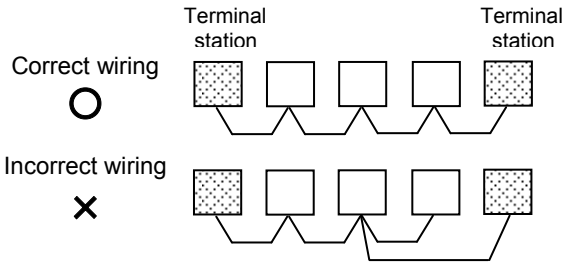
・Be sure to connect with daisy chain the RS485 transmission line between each unit.
Do not use a splitter. (Fig. 2)

・To avoid noise, separate the transmission line from high-voltage line (power supply, voltage line).

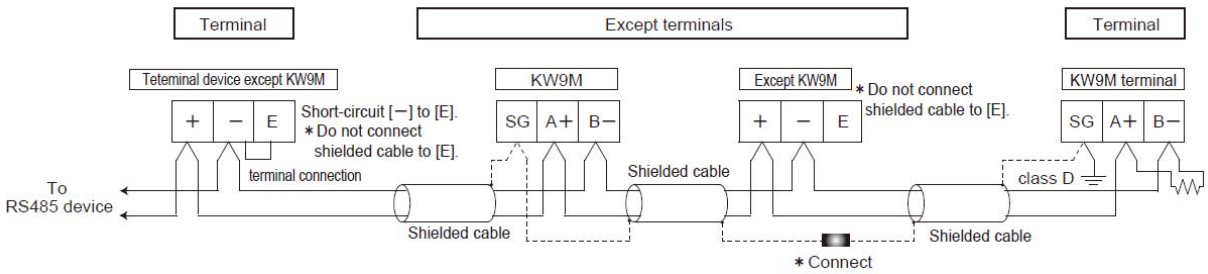
(Fig.1)



(Fig.2)



◆How to connect KW9M and the other devices with 2-wire system



Chapter 4 Settings

You can set parameters for measuring and the other functions using the keys on Eco-POWER METER. After wiring Eco-POWER METER and CT, power on and set the parameter for power measurement, Eco-POWER Meter can measure the electric power. In order to use the other functions, set other parameters according to your use.

◆Keys' functions at setting mode

<MODE>	Shift to setting mode
<SET>	Set the items and values
<SHIFT/▽>, <ITEM/△>	Select items and change values

◆Parameters for power measurement

Item	Range	Initial value
Phase/Wire system	1P2W, 1P3W, 3P3W 3P4W	1P2W
CT type	1, 5 [A]	5A
Primary side current of CT	1 to 4000 [A]	5A
VT ratio	1.00 to 600.00	1.00
Conversion rate (P)	0.00 to 99.99/1kWh	10.00
Conversion rate (-P)	0.00 to 99.99/1kWh	10.00

◆Parameters for communication

Item	Range		Initial value
Protocol	MEWTOCOL, MODBUS(RTU), DL/T645-2007		MEWTOCOL
Device number	MEWTOCOL	1 to 99	1
	MODBUS(RTU)	1 to 247	
	DL/T645-2007	0 to 9999	
Transmission speed	38400, 19200, 9600,4800, 2400, 1200 [bps]		19200
Transmission format	8b-o(8bit odd), 8b-n(8bit none), 8bit-E(8bit even)		8b-o
Stop bit	1,2		1
Response time	1 to 99 [ms]		5

◆Parameters for optional functions

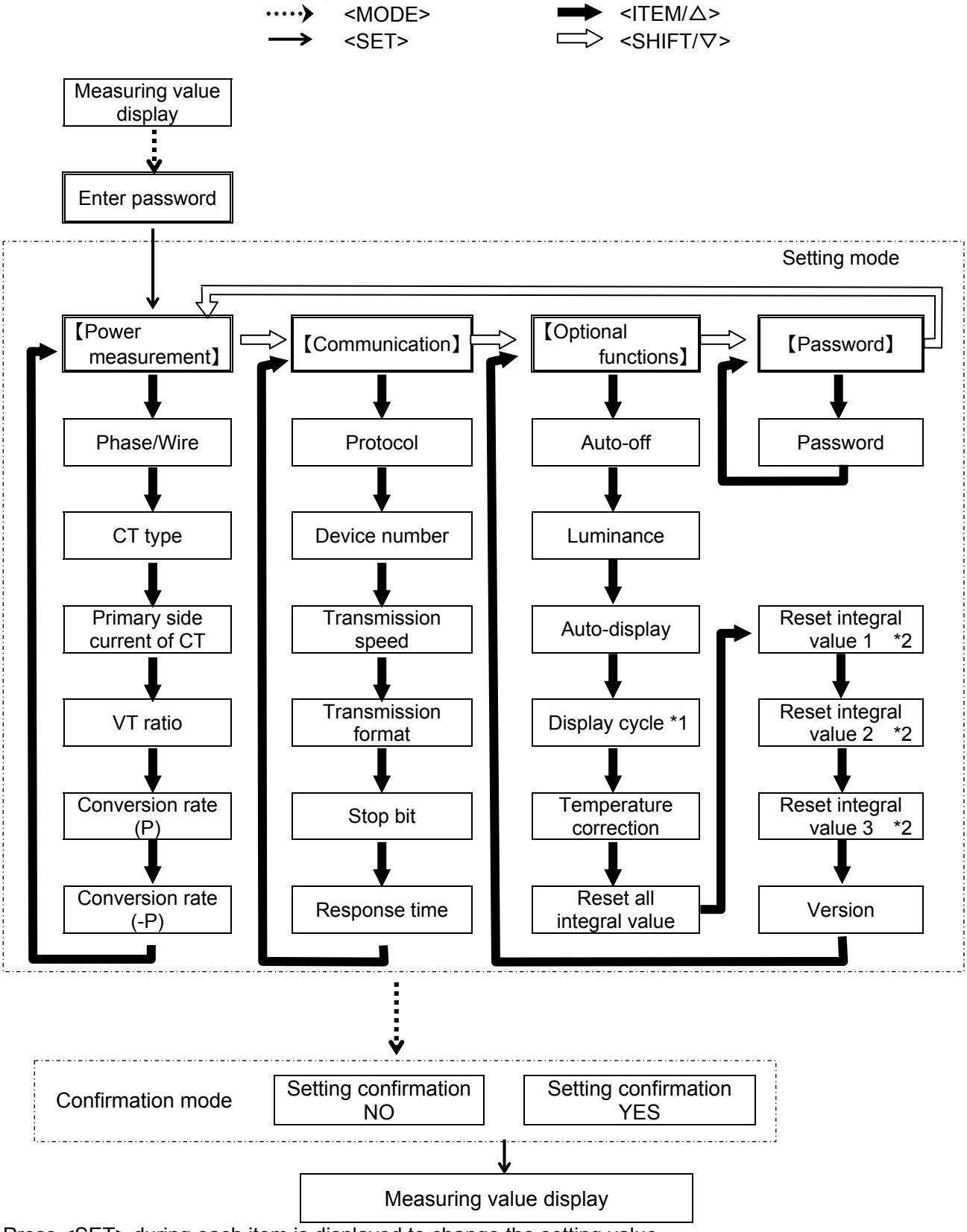
Item	Range	Initial value
Auto-off	0 to 99 [min.]	1
Luminance	1, 2, 3, 4, 5 (1: dark to 5:light)	3
Auto display start	0 to 99 [min.]	10
Display cycle	1 to 99 [sec.]	5
Temperature correction	-100.0 to 100.0	0.0
Reset all integral value	YES, NO	NO
Reset integral value 1	YES, NO	NO
Reset integral value 2	YES, NO	NO
Reset integral value 3	YES, NO	NO
Version		

◆Password

Item	Range	Initial value
Password change	0000 to 9999	0000

4.1 Setting Flow

Arrow mark means press each key



Press <SET> during each item is displayed to change the setting value.

Press <MODE> to display the confirmation window. Select [YES] and press <SET> to decide the setting value. However no value is changed, the confirmation window is skipped and it displays the measuring vaolue display.

*1 It skips when [0] is set at auto-display setting.

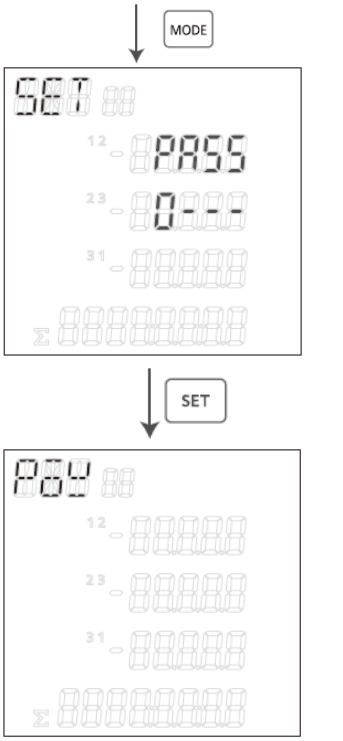
*2 It skips when [YES] is selested at reset all integral value.

4.2 Password entry

It is necessary to enter password to shift to setting mode.
Enter [0000] and shift to password setting mode when you set password at the first time.
*When setting password, be careful for handling and note it.

Measuring value display

Press <MODE> and it shifts to password entry window.



Enter password from left to right using <ITEM/△>, <SHIFT/▽>.

ITEM/△ Increase

SHIFT/▽ Shift entered digit to the right

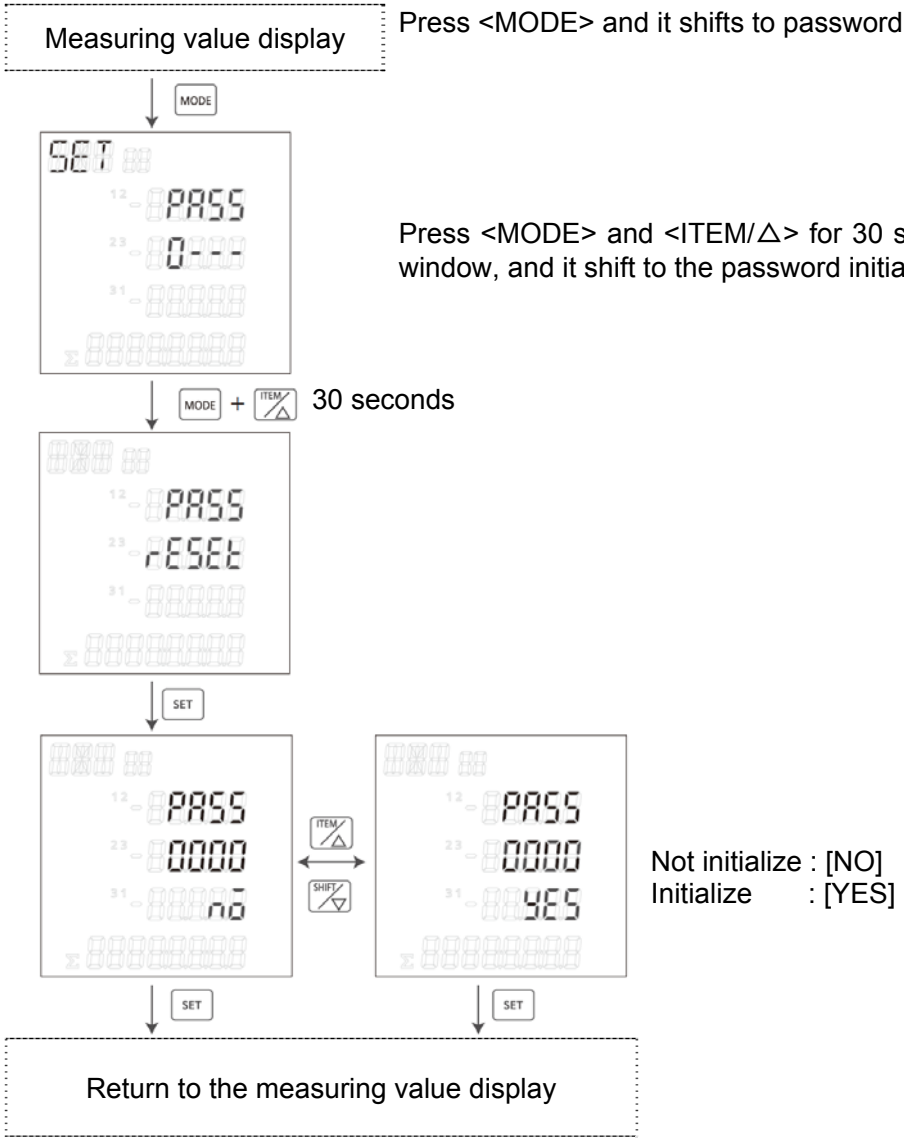
Press <SET> after enter the password.

If the password is correct, it shift to setting mode of power measurement.

If the password is wrong, [FAIL] is displayed and it returns to the password entry window.
*If you make wrong password 5 times, you can't set 1-hour after.

4.3 Password initialize

When you forget the password, initialize it in the following procedures. (Initial: [0000])
It is impossible to decode the set password.



Press <MODE> and it shifts to password entry window.

Press <MODE> and <ITEM/△> for 30 seconds in the password entry window, and it shift to the password initialize window.

Not initialize : [NO]
Initialize : [YES]

4.4 How to Set

■Set before measuring.

Select setting item with <ITEM/△> and press <SET>, and the value will be blinking.

Set with <ITEM/△> and <SHIFT/▽>.

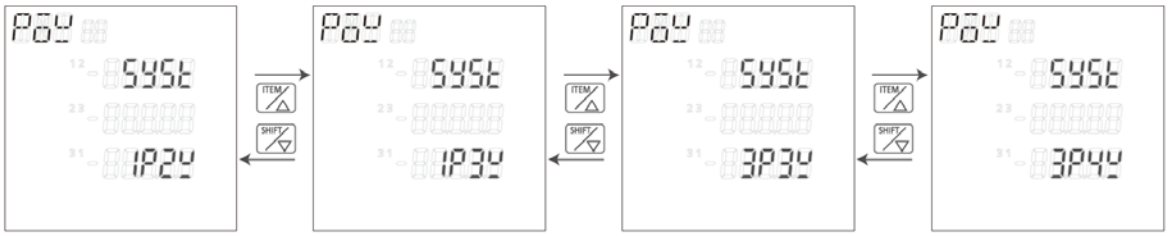
When you select [YES] with the confirmation window and press <SET>, the setting values are settled.

4.4.1 Settings for power measurement

Phase/Wire system SYST

Select phase/wire system to measure.

Press <ITEM/△>, <SHIFT/▽> to select phase/wire system.

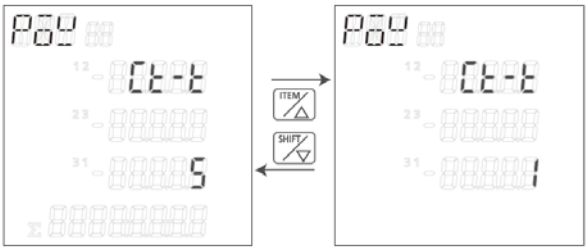


[Set list] 1P2W, 1P3W, 3P3W, 3P4W (initial: 1P2W)

* When the system is not matched with the measure system, it doesn't measure correctly.

CT type CT-T

Select using CT type (secondary side current).



Press <ITEM/△>, <SHIFT/▽> to select CT type.

[Set list] 5 (5A), 1 (1A) (initial: 5)

To use CT with secondary side current 5A; [5]

To use CT with secondary side current 1A: [1]

Primary side current of CT CT-1

Set the primary side current of using CT.

Enter the primary side current of CT that is set at CT type setting.

Press <ITEM/△>, <SHIFT/▽> to set.

[Set range] 1 to 4000 (initial:5)

ITEM/△ Increase

SHIFT/▽ decrease

Primary side current of using CT is 400A: [400]

VT ratio VT

Select the voltage input method, input voltage directly or uses a voltage transformer (VT: secondary side rating 110V) and set VT ratio.

Press <ITEM/△>, <SHIFT/▽> to set.
[Set range] 1.00 to 600.00 (initial:1.00)

increase

decrease

Input directly without VT: [1.00]
Use VT : [1.01 to 600.00]

*When input voltage is under 3V (VT ratio = 1), [0.0] is displayed and it doesn't measure.

Conversion rate (P) RATE P

Set the conversion rate per integral active power 1 kWh.

Press <ITEM/△>, <SHIFT/▽> to set.

[set range] 0.00 to 99.99/1kWh (initial:10.00)

increase

decrease

Conversion rate (-P) RATE -P

Set the conversion rate per integral export power (-P) 1kWh.

Press <ITEM/△>, <SHIFT/▽> to set.

[set range] 0.00 to 99.99/1kWh (initial:10.00)

increase

decrease

4.4.2 Settings for communication

Protocol PROT

Select protocol for of main unit via serial communication (RS485).

*When protocol is changed, device number, transmission speed (baud rate), transmission format, stop bit and response time will be initialized.

Press <ITEM/△>, <SHIFT/▽> to select.

[Set list] MEWT(MEWTOCOL), MODr (MODBUS(RTU)), 645(DL/T645-2007)
(initial: MEWT)

Device number NO

Set an individual device number for each unit when two or more units are connected to communicate via serial communication (RS485).

Press <ITEM/△>, <SHIFT/▽> to set.
The setting range differs according to the protocol.

[Set range] MEWTOCOL: 1 to 99
MODBUS(RTU): 1 to 247
DL/T645-2007: 0 to 9999 (initial:1)

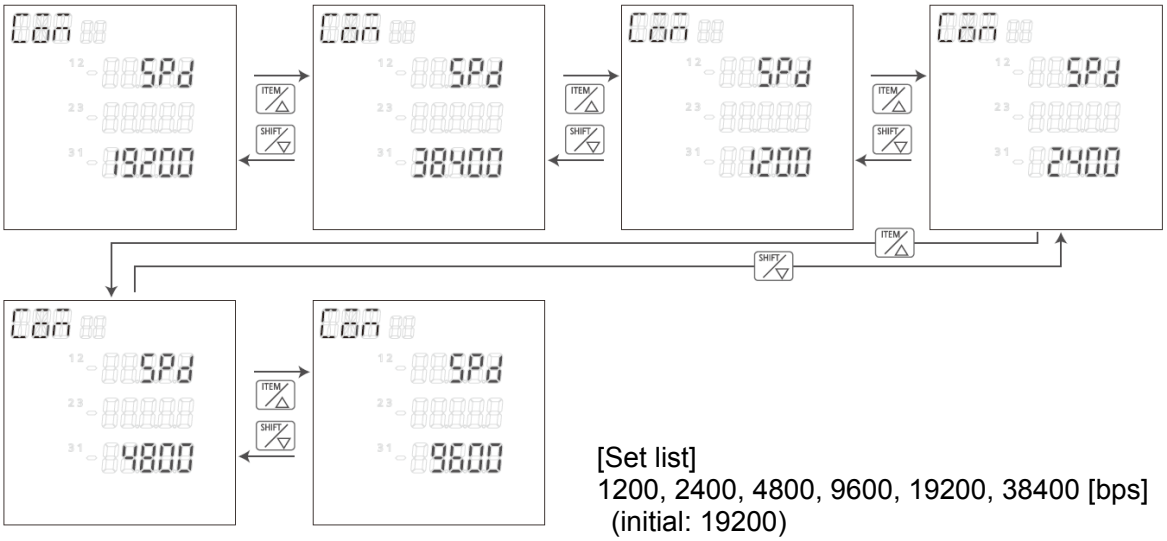
increase

decrease

Transmission speed (Baud rate) SPD

Select the serial communication (RS485) transmission speed.
Define the transmission speed according to the master's (PLC etc.).

Press <ITEM/△>, <SHIFT/▽> to select.



[Set list]
1200, 2400, 4800, 9600, 19200, 38400 [bps]
(initial: 19200)

Transmission format FMT

*Select [8b-E] when [645] is set for the protocol.

Select serial communication (RS485) transmission format (Data length, Parity).
Define the transmission format according to the master's (PLC etc.).

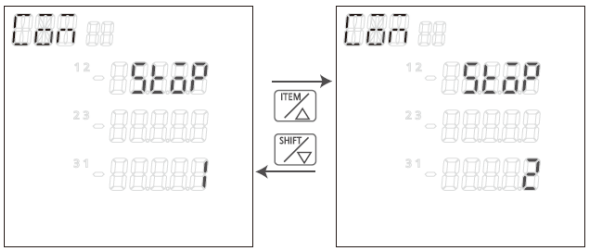
Press <ITEM/△>, <SHIFT/▽> to select.

[Set list] 8b-o (8bit odd), 8b-n (8bit none), 8b-E (8bit even) (initial: 8b-o)

Stop bit STOP

*Select [1] when [645] is set for the protocol.

Select serial communication (RS485) stop bit.



Press <ITEM/△>, <SHIFT/▽> to select.

[Set list] 1, 2 (initial: 1)

Response time RESP

*Select 50 or more when [645] is set for the protocol.

Set serial communication (RS485) response time of main unit.
When command is received, it sends response after setting response time passes.

Press <ITEM/△>, <SHIFT/▽> to set.

[Set range] 1 to 99 ms (initial: 5)

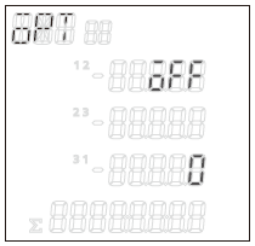
increase

decrease

4.4.3 Settings for optional functions

Auto-off OFF

Display LCD turns off automatically when there is no key operation for a long time.
After it passes the setting time, backlight will turn off.



Set <ITEM/△>, <SHIFT/▽> to set.

[Set range] 0 to 99 min. (initial:1)

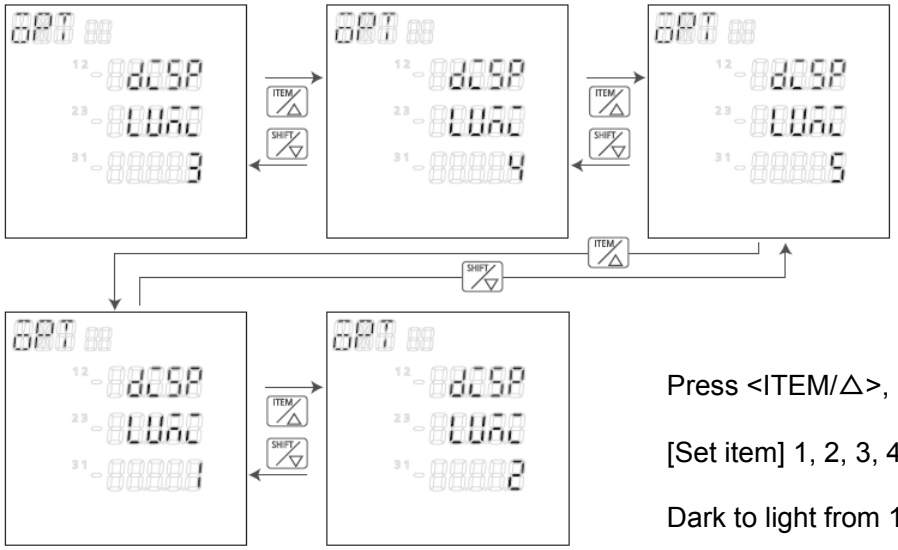
increase

decrease

Always turn on : [0]
Turn off after setting time: [1～99]
After turns off the LCD, any key operation makes it turns on.

Luminance DISP LUMI

Adjust the display luminance.



Press <ITEM/△>, <SHIFT/▽> to select.

[Set item] 1, 2, 3, 4, 5 (initial: 3)

Dark to light from 1 to 5

Auto-display AUTO DISP

It shifts items of each integral value automatically.
When it passes the setting time after key operation, the integral value is shifted automatically.

Press <ITEM/△>, <SHIFT/▽> to set.

[Set range] 0 to 99 min. (initial:10)

increase

decrease

Not change automatically : [0]
Chang automatically after the setting time: [1 to 99]
*Any key operation during auto-display makes the display shift to instantaneous active power.

Display cycle DISP CYCLE

*It skips this item when [0] is set for auto-display.

Set each display cycle during auto-display.

Press <ITEM/△>, <SHIFT/▽> to set.

[Set range] 1 to 99 sec (initial:5)

increase

decrease

Shift every 1second: [1]

*Any key operation during auto-display makes the display shift to instantaneous active power.

Temperature correction TEMP CORRE

The measured temperature can be corrected to display.

Press <ITEM/△>, <SHIFT/▽> to set.

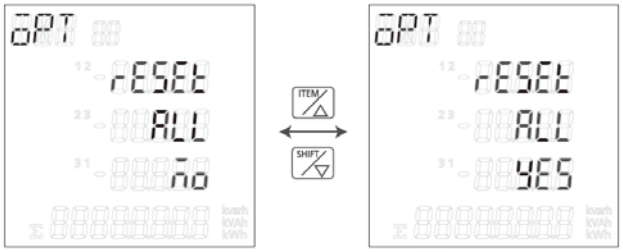
[Set range] -100.0 to 100.0 (initial: 0.0)

increase

decrease

Reset all integral value RESET ALL

Integral power (active, reactive, apparent) can be reset at one time.



Press <ITEM/△>, <SHIFT/▽> to select.

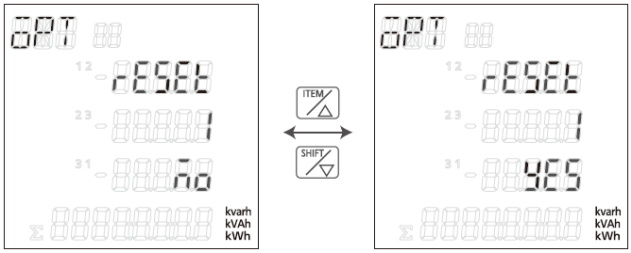
[Set list] YES, NO (initial: NO)

Reset all : [YES]
Not reset : [NO]

Reset integral value 1 RESET 1

*It skips this item when [YES] is selected for reset all integral value.

Reset the integral power of 1CH/1-phase (active, reactive, apparent) and integral export power of 1CH/1-phase (active, reactive).



Press <ITEM/△>, <SHIFT/▽> to select.

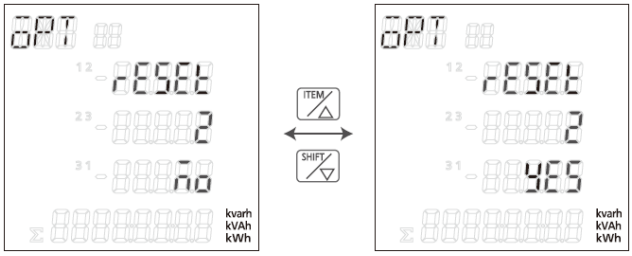
[Set list] YES, NO (initial: NO)

Reset : [YES]
Not reset : [NO]

Reset integral value 2 RESET 2

*It skips this item when [YES] is selected for reset all integral value.

Reset the integral power of 2CH/2-phase (active, reactive, apparent) and integral export power of 2CH/2-phase (active, reactive).



Press <ITEM/△>, <SHIFT/▽> to select.

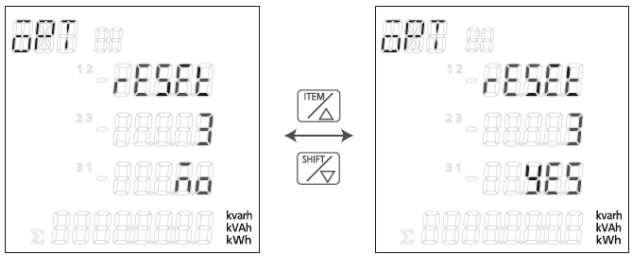
[Set list] YES, NO (initial: NO)

Reset : [YES]
Not reset : [NO]

Reset integral value 3 RESET 3

*It skips this item when [YES] is selected for reset all integral value.

Reset the integral power of 3CH/3-phase (active, reactive, apparent) and integral export power of 3CH/3-phase (active, reactive).



Press <ITEM/△>, <SHIFT/▽> to select.

[Set list] YES, NO (initial: NO)

Reset : [YES]
Not reset : [NO]

Version VER

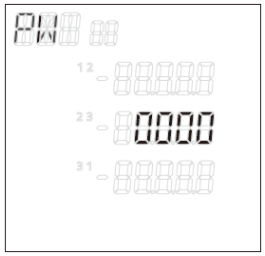
You can check the software version.

It displays the software version.

4.4.4 Password setting

Password setting PASS

You can set password for changing the settings.
It is necessary to enter the password before moving the setting mode.
We recommend you to set password to avoid unexpected change.



Press <SET> and [0] on the left is blinking.
Set password using <ITEM/△>, <SHIFT/▽>.

Increase

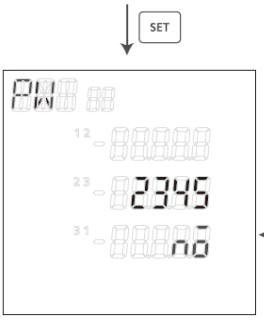
Shift entered digit to the right

Set from left to right. Make the digit to set blink.

[Set range] 0000 to 9999 (initial: 0000)

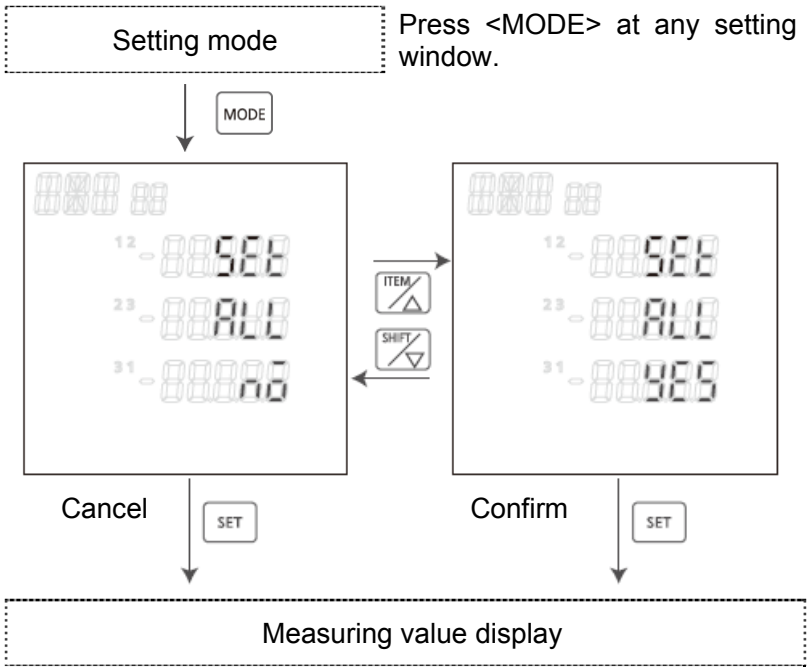
Set 4-digit password and press <SET>
After that the confirm window is displayed.

[Set range] YES, NO (initial: NO)



Confirm: [YES]
Not confirm: [NO]

4.4.5 Confirmation window



Press <MODE> at any setting window and it shifts to confirmation window.

[Set list] YES, NO (initial: NO)

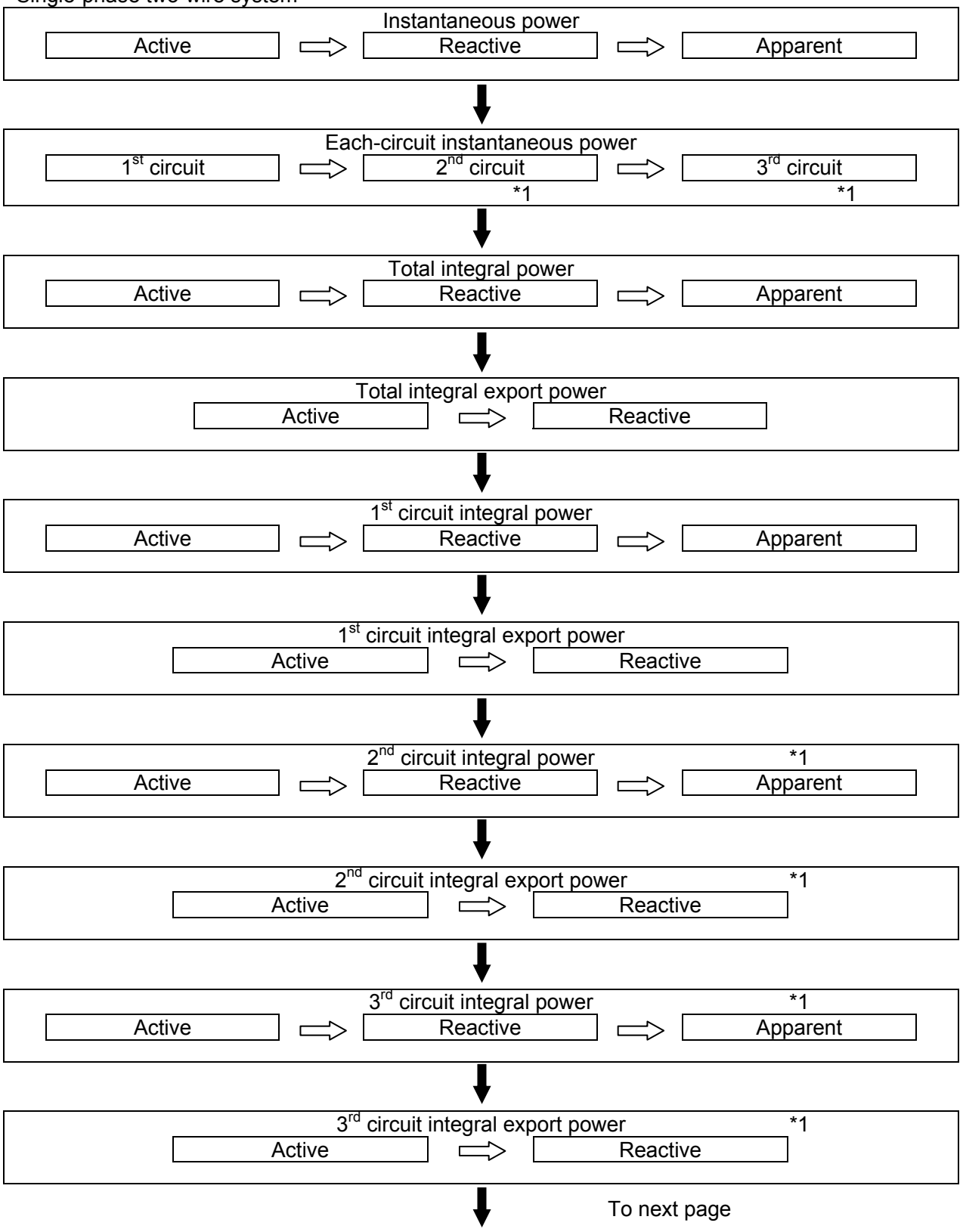
Confirm the change: [YES]
Cancel the change: [NO]

Chapter 5 Display of each Value

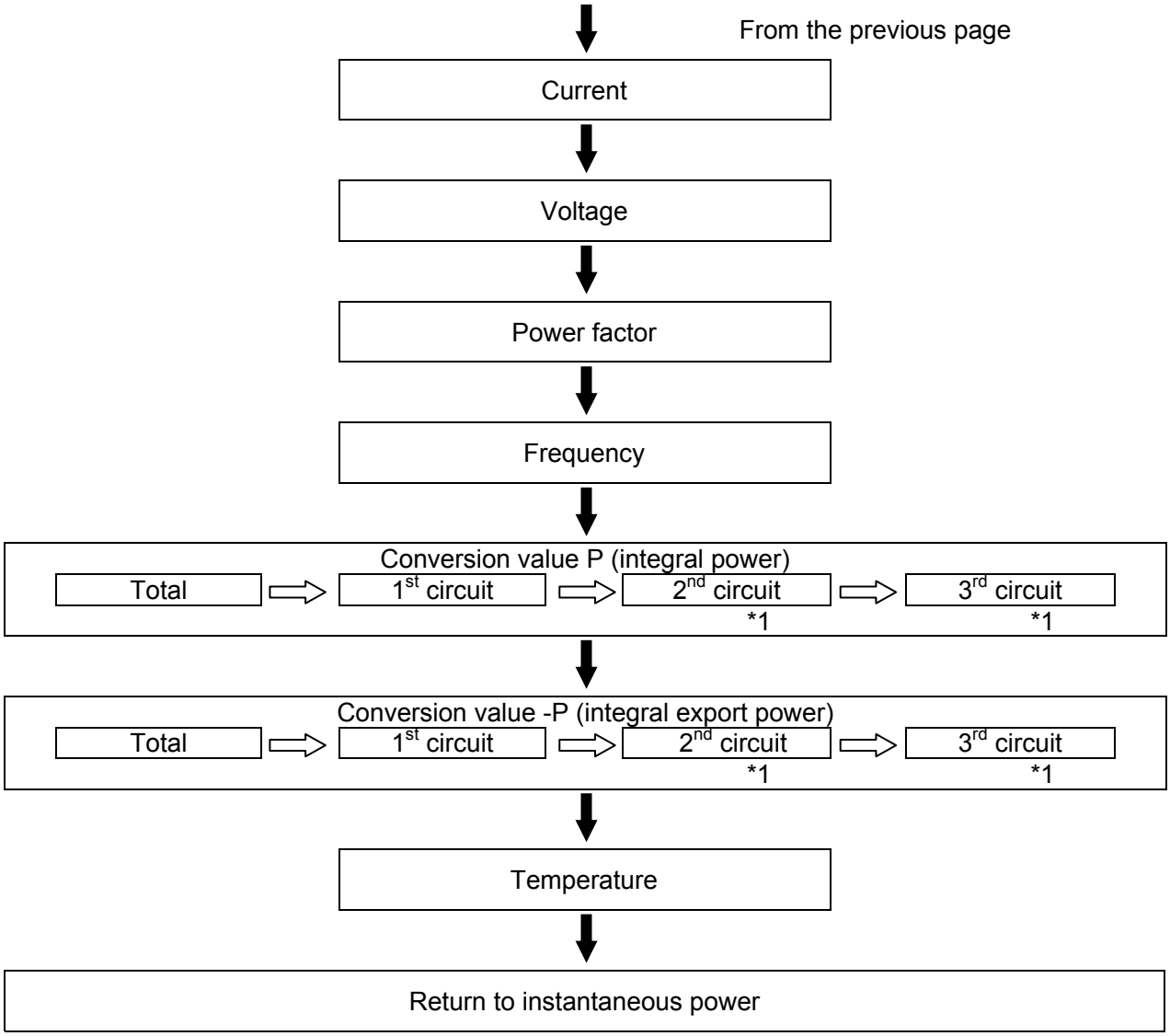
5.1 Working of Monitor Display

Arrow mark shows to press each key. ➡ <ITEM/△> ⇨ SHIFT/▽>

<Single-phase two-wire system>



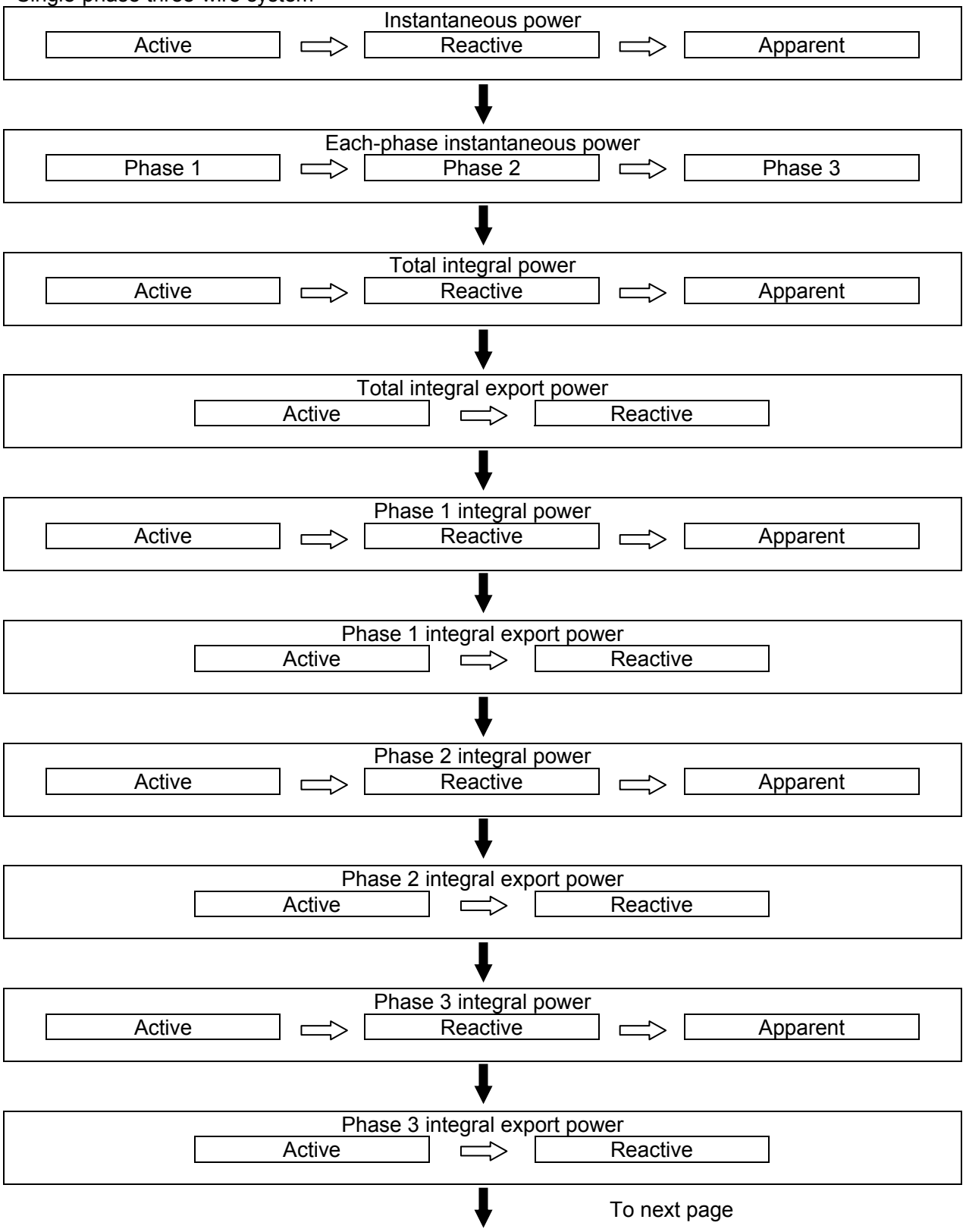
To next page



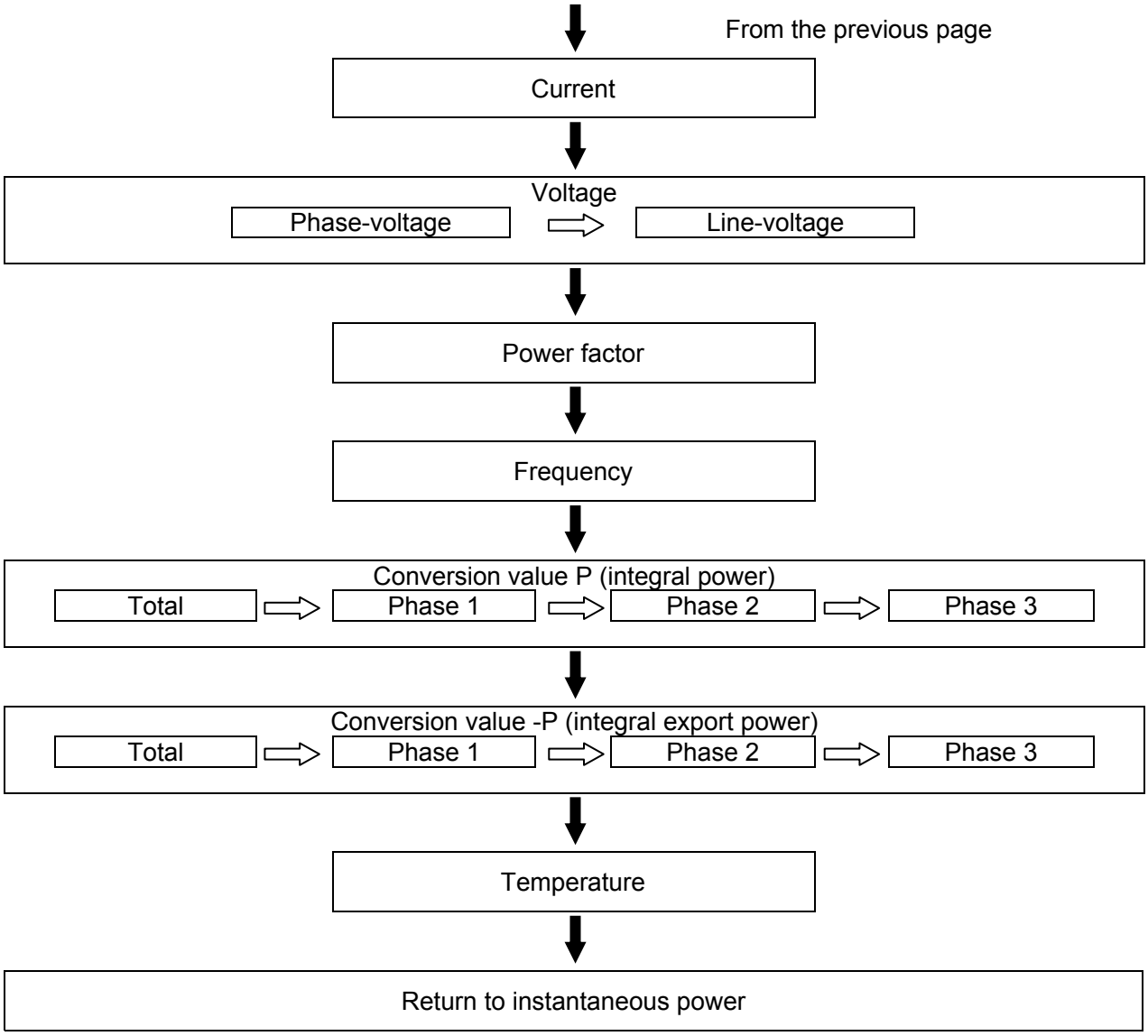
*1) When 2nd circuit and 3rd circuit are not measured, [0] are displayed.

Arrow mark shows to press each key. ➡ <ITEM/△> ⇨ <SHIFT/▽>

<Single-phase three-wire system>

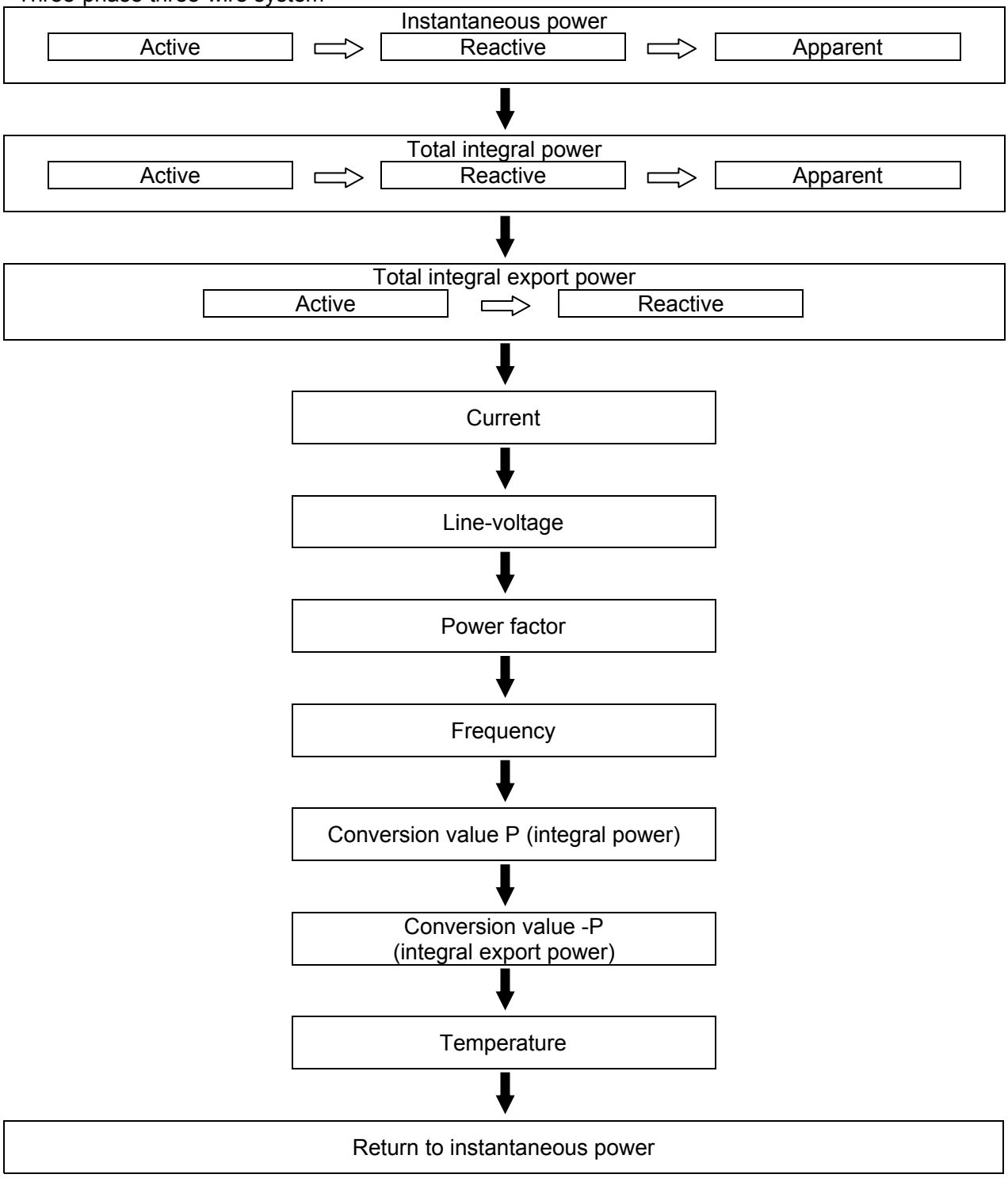


To next page


From the previous page
Current
Voltage
Phase-voltage
Line-voltage
Power factor
Frequency
Conversion value P (integral power)
Total
Phase 1
Phase 2
Phase 3
Conversion value -P (integral export power)
Total
Phase 1
Phase 2
Phase 3
Temperature
Return to instantaneous power

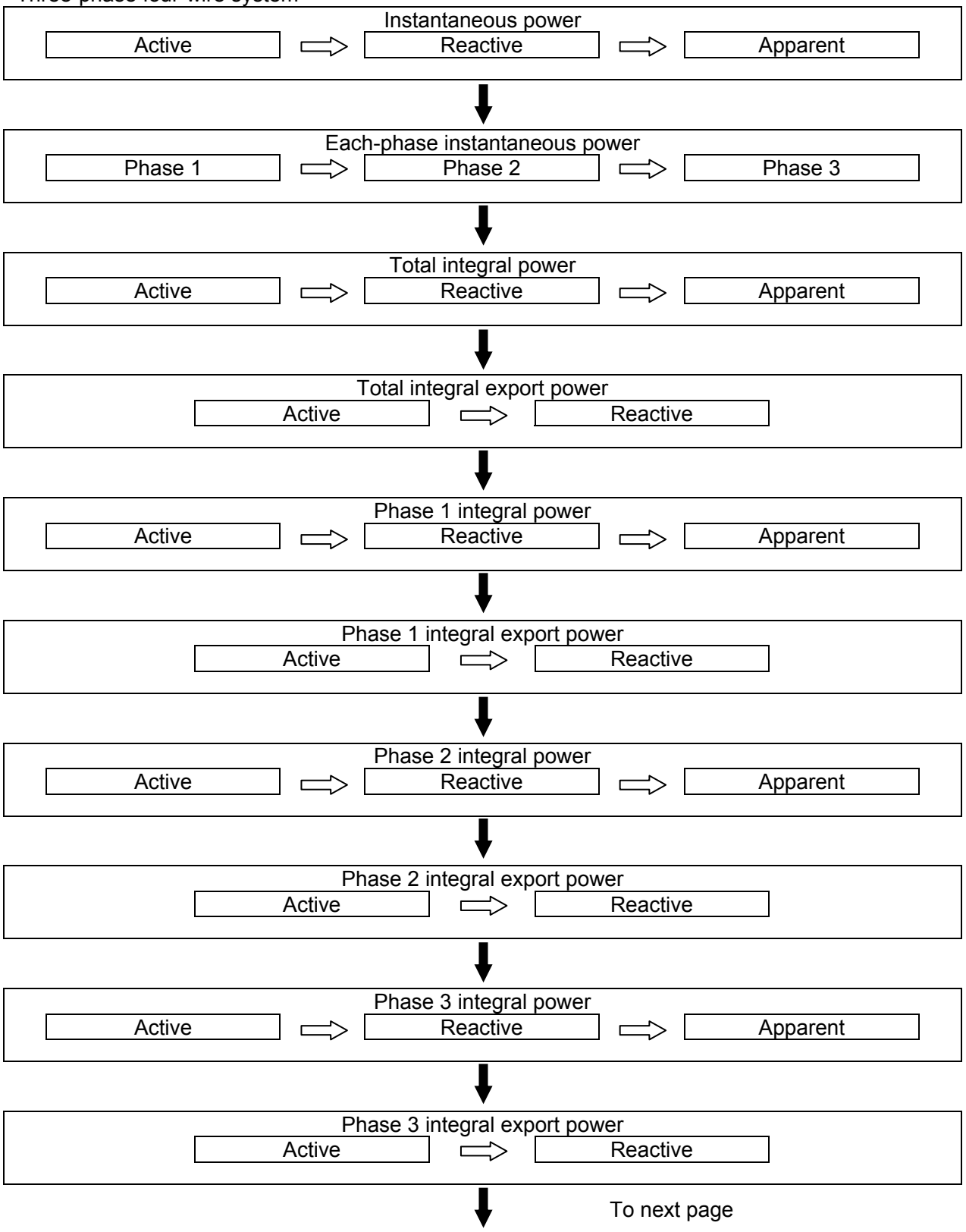
Arrow mark shows to press each key. ➡ <ITEM/△> ⇨ <SHIFT/▽>

<Three-phase three-wire system>

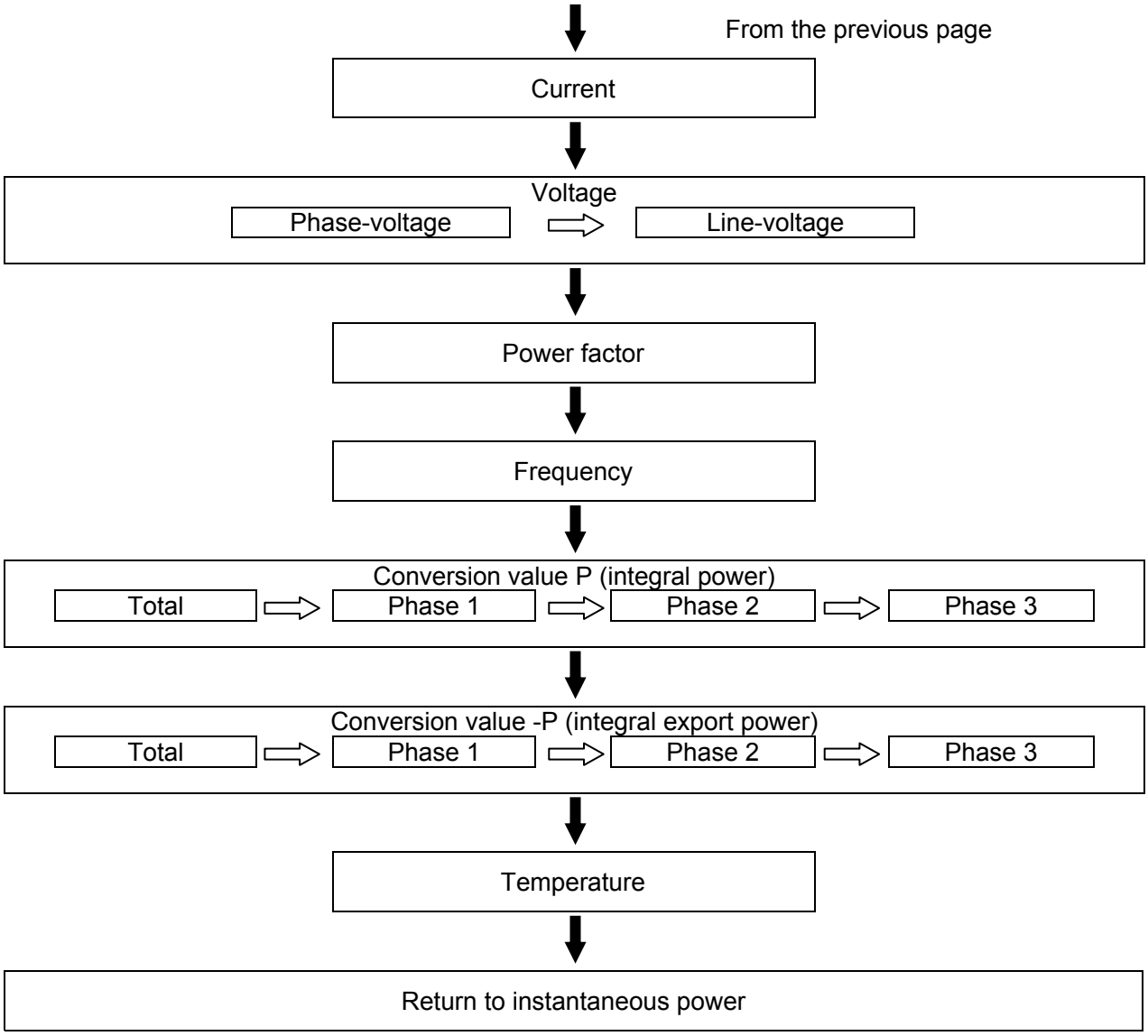


Arrow mark shows to press each key. ➡ <ITEM/△> ⇨ <SHIFT/▽>

<Three-phase four-wire system>

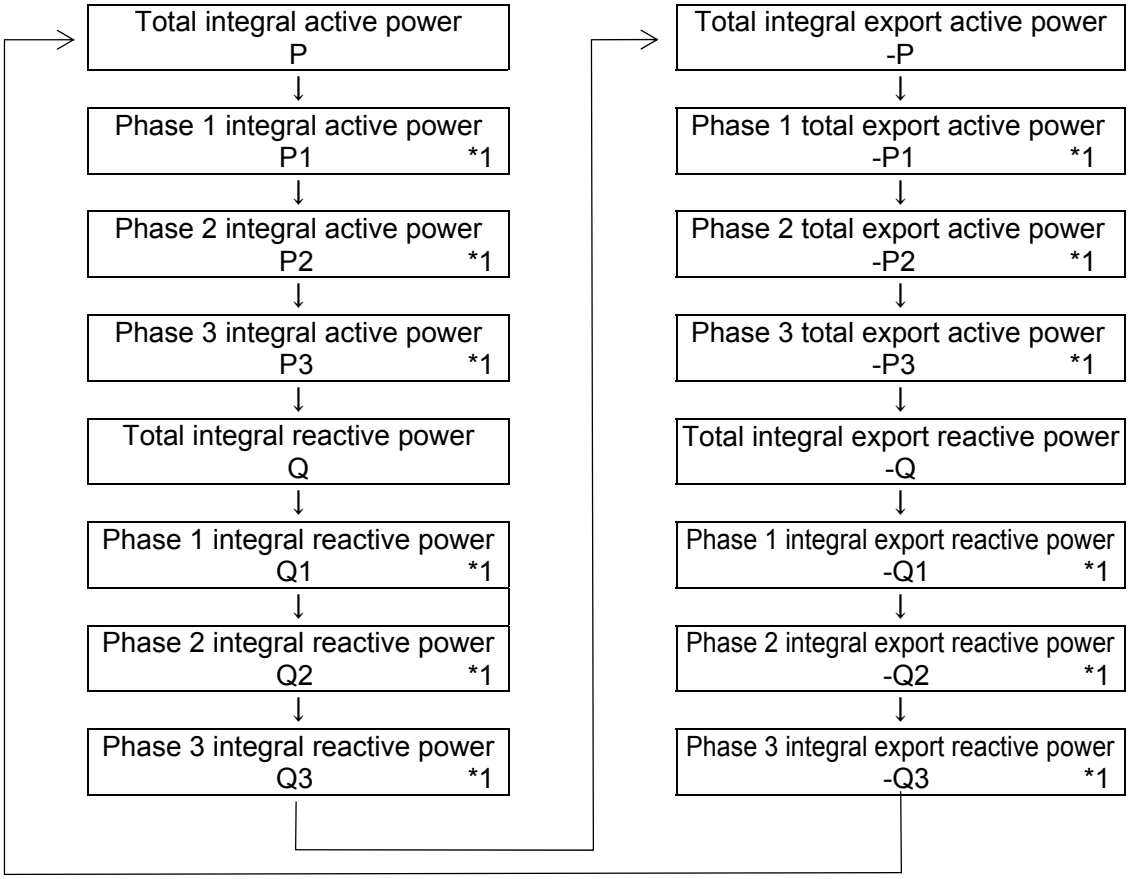


To next page


From the previous page
Current
Voltage
Phase-voltage
Line-voltage
Power factor
Frequency
Conversion value P (integral power)
Total
Phase 1
Phase 2
Phase 3
Conversion value -P (integral export power)
Total
Phase 1
Phase 2
Phase 3
Temperature
Return to instantaneous power

●Items that are displayed during the auto-display mode

When some value is set at auto-display setting, each integral value display is shifted automatically. If you press any key during auto-display mode, it returns the instantaneous power display. Items, which are not displayed according to the phase/wire system, are skipped



*1 Those are skipped when it set to three-phase three-wire system.

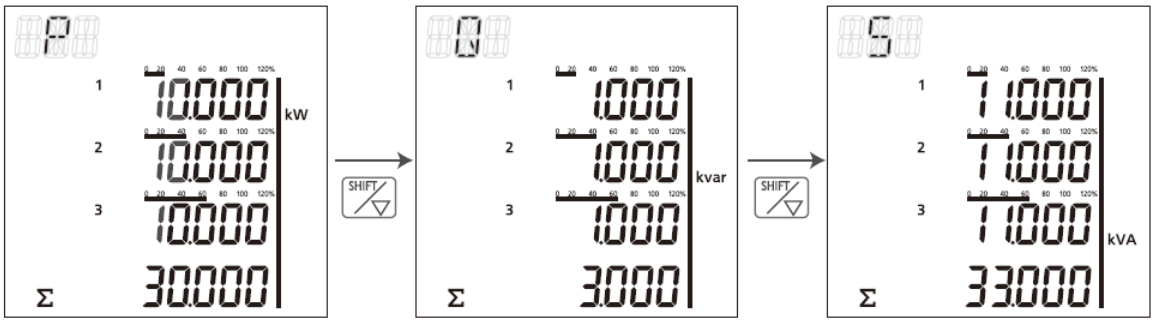
5.1.1 Instantaneous power

・The present instantaneous power of all phases or all circuits is displayed.

・Press <SHIFT/▽> to change active, reactive and apparent.

<1P2W/1P3W/3P4W>

Active Reactive Apparent



・Eco-POWER METER displays the power as below.

Display	1P2W	1P3W	3P4W
1	1st circuit	R-phase	R-phase
2	2nd circuit	---	S-phase
3	3rd circuit	T-phase	T-phase

<3P3W>

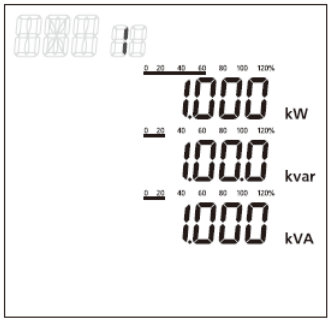
Active Reactive Apparent

5.1.2 Instantaneous power of each phase / each circuit

・The present instantaneous power of each phase or each circuit is displayed.
(It doesn't display for 3P3W system.)
・Press <SHIFT/▽> to change phase 1 (1st circuit), phase 2 (2nd circuit) and phase 3 (3rd circuit).

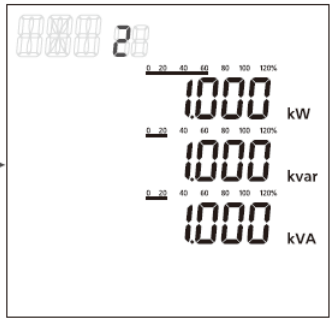
<1P2W/1P3W/3P4W>

Phase 1/ 1st circuit



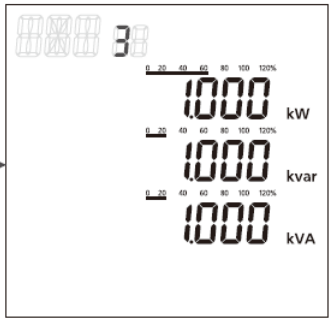
SHIFT/▽

Phase 2/ 2nd circuit



SHIFT/▽

Phase 3/ 3rd circuit



5.1.3 Total integral power

・The present total integral power is displayed.
・Press <SHIFT/▽> to change active, reactive and apparent.

<1P2W/1P3W/3P4W>

Active

SHIFT/▽

Reactive

SHIFT/▽

Apparent

<3P3W>

Active

SHIFT/▽

Reactive

SHIFT/▽

Apparent

・Total integral power is measured and displayed from 0.000 to 29999999 (kWh/kvarh/kVAh).
・The decimal point is changed automatically.

0.000 → 99999.999 → 100000.00 → 999999.99 → 1000000.0 → 29999999

(After reach the full scale, 29999999, the value reverts to 0.000 but continues to measure.)

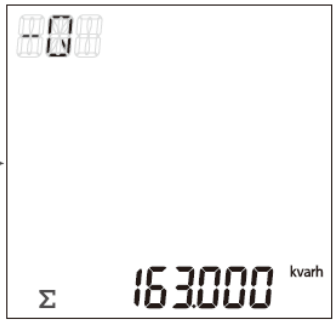
5.1.4 Total integral export power

・The present total export power is displayed.
・Press <SHIFT/▽> to change active, reactive and apparent.

<1P2W/1P3W/3P4W>

Active

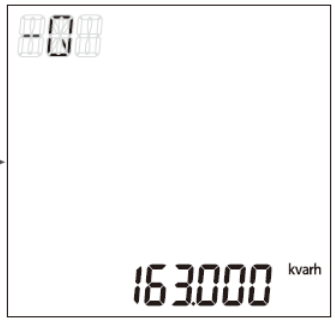
Reactive



<3P3W>

Active

Reactive



・Total integral power is measured and displayed from 0.000 to 29999999 (kWh/kvarh/kVAh).
・the decimal point is changed automatically.

0.000 → 99999.999 → 100000.00 → 999999.99 → 1000000.0 → 29999999

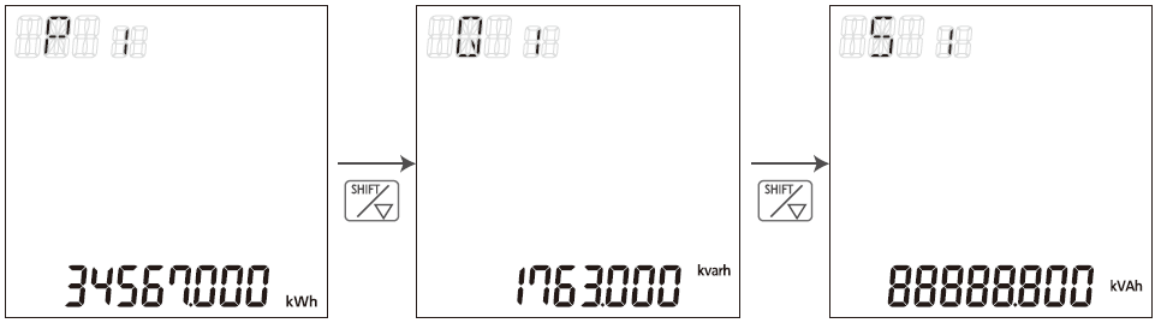
(After reach the full scale, 29999999, the value reverts to 0.000 but continues to measure.)

5.1.5 Integral power of each phase / each circuit

・The present integral power of each phase or each circuit is displayed.
(It doesn't display for 3P3W system.)
・Press <SHIFT/▽> to change active, reactive and apparent.

<1P2W/1P3W/3P4W>
Phase 1/ 1st circuit

Active → Reactive → Apparent



Phase 2/ 2nd circuit

Active → Reactive → Apparent

Phase 3/ 3rd circuit

Active → Reactive → Apparent

・Integral power is measured and displayed from 0.000 to 9999999.9 (kWh/kvarh/kVAh).
・The decimal points is changed automatically.

0.000 → 99999.999 → 100000.00 → 999999.99 → 9999999.9 → (back to 0.000)

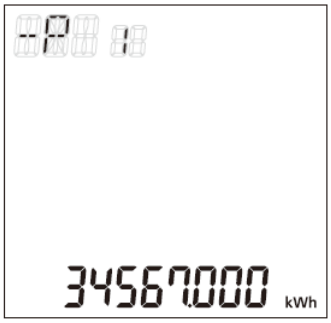
(After reach the full scale, 9999999.9, the value reverts to 0.000 but continues to measure.)

5.1.6 Integral export power of each phase / each circuit

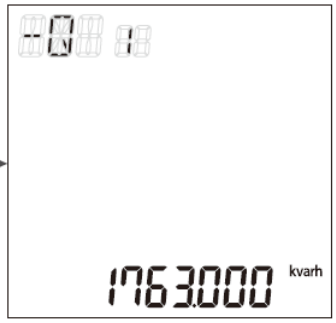
・The present integral export power of each phase or each circuit is displayed.
(It doesn't display for 3P3W system.)
・Press <SHIFT/▽> to change active, reactive and apparent.

<1P2W/1P3W/3P4W>
Phase 1/ 1st circuit

Active



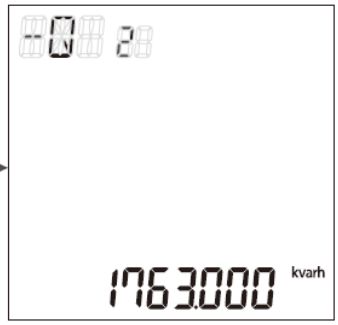
Reactive



Phase 2/ 2nd circuit

Active

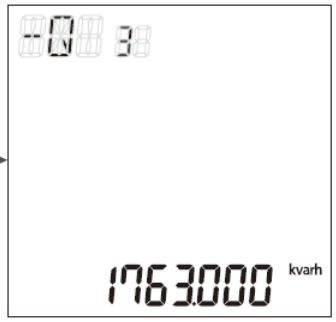
Reactive



Phase 3/ 3rd circuit

Active

Reactive



・Integral power is measured and displayed from 0.000 to 9999999.9 (kWh/kvarh).
・The decimal points is changed automatically.

0.000 → 99999.999 → 100000.00 → 999999.99 → 9999999.9 →

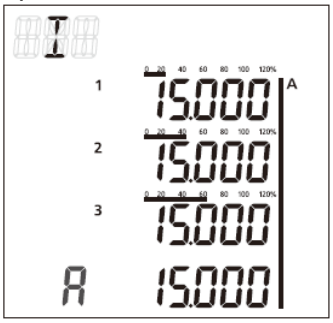
(After reach the full scale, 9999999.9, the value reverts to 0.000 but continues to measure.)

How to reset integral power (active/reactive/apparent) and integral export power (active/reactive)

・You can reset the value at the optional functions settings.
Refer to 4.4.3 setting for optional functions in detail.

5.1.7 Current

・The present current value is displayed.



・It measures from 0.1% of CT secondary current.

・When input current exceeds 200% or the display range, it displays "- - - - -".

・Current measuring points

Eco-POWER METER measures the current as below.

Display	1P2W	1P3W	3P3W 3P4W
1	1st circuit R-current	R-current	R-current
2	2nd circuit R-current	N-current	S-current
3	3rd circuit R-current	T-current	T-current

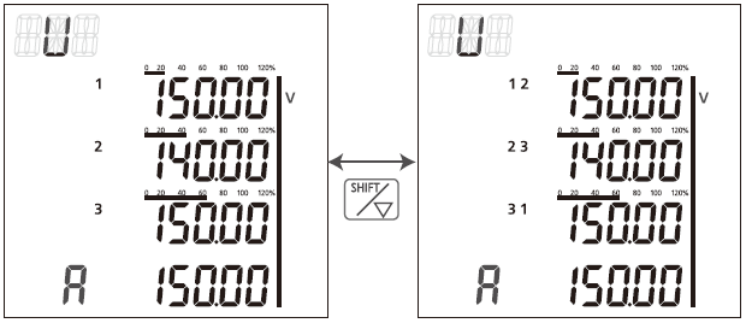
5.1.8 Voltage

・The present voltage is displayed.

・Press <SHIFT/▽> to change phase voltage and line voltage.

(Line voltage is not displayed for 1P2W system. Phase voltage is not displayed for 3P3W system.

Phase voltage Line voltage



・When input voltage is under 3V (when VT ratio is 1.), it displays "0.0" and doesn't measure.

・When input voltage exceeds 600V or the display range, it displays "- - - - -".

・Voltage measuring points

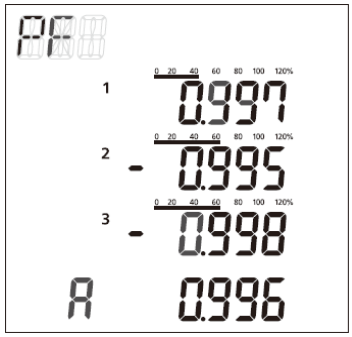
Eco-POWER METER measures the voltage as below.

Display	1P2W	1P3W	3P3W	3P4W
1	R-voltage (L1-N) or 1st circuit R-voltage	R-voltage (L1-N)	No display	R-voltage (L1-N)
2	None or 2nd circuit R-voltage	None		S-voltage (L2-N)
3	None or 3rd circuit R-voltage	T-voltage (L3-N)		T-voltage (L3-N)
1 2	No display	R-voltage (L1-N)	RS-voltage (L1-L2)	RS-voltage (L1-L2)
2 3		T-voltage (L3-N)	ST-voltage (L2-L3)	ST-voltage (L2-L3)
3 1		TR-voltage (L3-L1)	TR-voltage (L3-L1)	TR-voltage (L3-L1)

5.1.9 Power factor

・The present power factor of the load is displayed.

<1P2W/1P3W/3P4W>



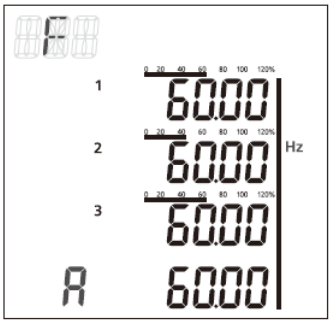
<3P3W>

*Power factor operation is a method assuming balanced load. The error might be big when it measures unbalanced load.

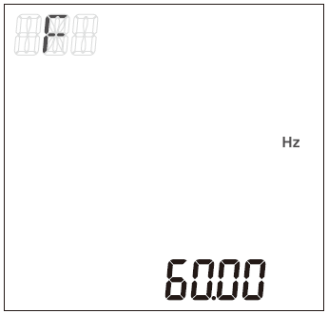
5.1.10 Frequency

・The present frequency is displayed.

<1P2W/1P3W/3P4W>



<3P3W>



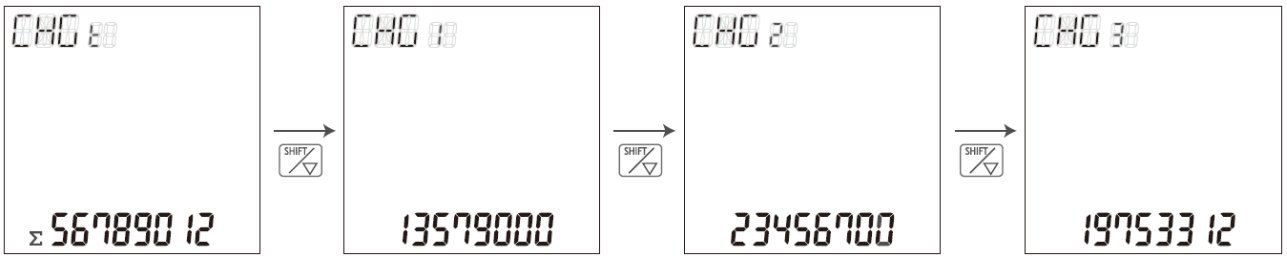
5.1.11 Conversion value for integral active power

・The conversion value for the present integral active power (P) is displayed.
(Only total conversion value is displayed for 3P3W system.)

・Press <SHIFT/▽> to change total, phase 1 (1st circuit), phase 2 (2nd circuit) and phase 3 (3rd circuit).

<1P2W/1P3W/3P4W>

Total → Phase 1 (1st circuit) → Phase 2 (2nd circuit) → Phase 3 (3rd circuit)



<3P3W>

Total

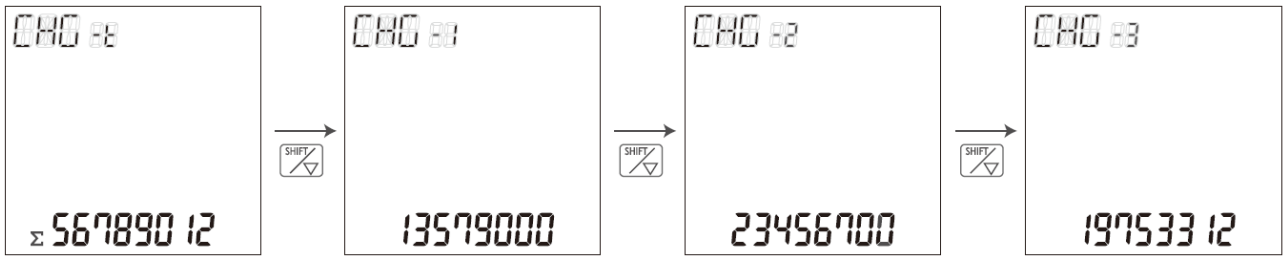
*The conversion value exceeds “99999999”, “－－－－－－－－” is displayed.

5.1.12 Conversion value for integral export power

・The conversion value for the present integral export active power (-P) is displayed.
(Only total conversion value is displayed for 3P3W.)
・Press <SHIFT/▽> to change total, phase 1 (1st circuit), phase 2 (2nd circuit) and phase 3 (3rd circuit).

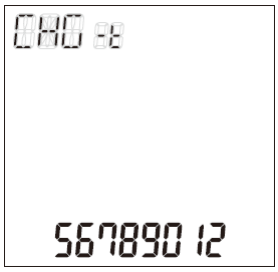
<1P2W/1P3W/3P4W>

Total Phase 1 (1st circuit) Phase 2 (2nd circuit) Phase 3 (3rd circuit)



<3P3W>

Total



*The conversion value exceeds “99999999”, “－－－－－－－－” is displayed.

5.1.13 Temperature

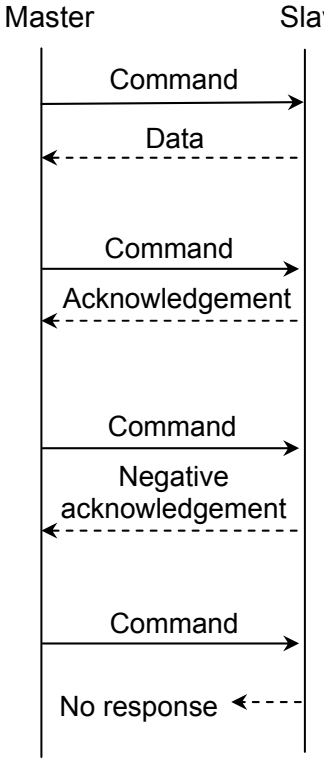
・The present temperature is displayed.

・Temperature measuring function is the simple function Use this only to check temperature trend and do not use for control.
・It measures by built-in thermistor, therefore it differs the measuring value according to the internal circuit conditions (communication, input current). Use it for your reference.
・When the temperature of the front is much different from the temperature of installed panel, when it cools inside the panel, it is impossible to measure correctly. Use the temperature correction function in order to adjust the temperature and use only to check temperature trend.

Chapter 6 Communications

6.1 Communication Procedures

Communication starts with command transmission from the host computer (hereafter Master) and ends with the response of Eco-POWER METER (hereafter Slave).



• Response with data
When master sends reading command, slave responds with the corresponding set value or current status.

• Acknowledgement
When master sends setting command, slave responds by sending the acknowledgement.

• Negative acknowledgement
When master sends a non-existent command or value out of the setting range, the slave returns negative acknowledgement.

• No response
Slave will not respond to master in the following cases.
- Global address “FF” (MEWTOCOL) is set.
- Broadcast address “00H” (Modbus protocol) is set.
- Communication error (framing error, parity error)
- CRC-16 discrepancy (Modbus RTU mode)
- CS discrepancy (DL/T645)

6.2 Communication timing

◆The minimum access time from the master is 1 sec. (Minimum time for update the data)
Eco-POWER METER may not response due to noise and so on, be sure to check that it receives the response from Eco-POWER METER.

◆In order to improve the communication quality, we recommend to send the transmission again.

Communication timing of RS485

◇Eco-POWER METER (Slave) side

When Eco-POWER METER (Slave) starts transmission to RS485 communication line, it is arranged so as to provide an idle status transmission period of about 1 to 99ms (setting available) before sending the response to ensure the synchronization on the receiving side. After sending the response, master can disconnect the transmitter from the communication line within transmission period 20ms.

◇Master side (Cautions of setting a program)

At communication, keep the following conditions.

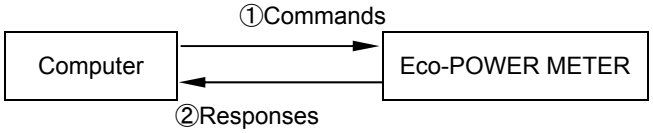
1) Set the program so that the master can disconnect the transmitter from the communication line within the transmission period of about 20ms after sending the command in preparation for reception of the response from Eco-POWER METER (Slave).
2) To avoid collision of transmissions between the master and Eco-POWER METER (Slave), send a next command after checking that the master received the response.

6.3 MEWTOCOL Communication

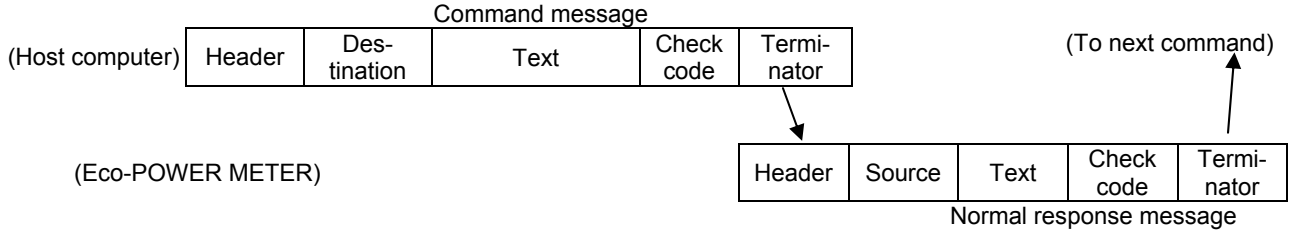
6.3.1 Overview of MEWTOCOL-COM (RS485)

◆Command and response functions

The computer sends commands (instructions) to Eco-POWER METER, and receives responses in return. This enables the computer and Eco-POWER METER to converse with each other, so that various kinds of information can be obtained and provided.



◆Command and response formats



◇Control codes

Name	Character	ASCII code	Explanation
Header	%	25H	Indicates the beginning of a message.
Command	#	23H	Indicates that the data comprises a command message.
Normal response	$	24H	Indicates that the data comprises a normal response message.
Error response	!	21H	Indicates that the data comprises a response message when an error occurs.
Terminator	CR	0DH	Indicates the end of a message.

◇Destination and source AD (H), (L)

Two-digit decimal 01 to 99 (ASCII codes)

Command messages contain a station number for Eco-POWER METER that receives the message.

When FF (ASCII code table) is used, however, the transmission is a global transmission (sent to all stations at once).

Note) When a global transmission is sent, no response to the command message is returned.

◇Block check code Bcc (H), (L)

Two- digit hexadecimal 00 to FF (ASCII codes)

These are codes (horizontal parity) that are used to detect errors in the transmitted data.

If "**" is entered instead of "Bcc", however, messages can be transmitted without the Bcc. In this case, the Bcc is included with the response

◇Error code Err (H), (L)

Two- digit hexadecimal 00 to FF (ASCII codes)

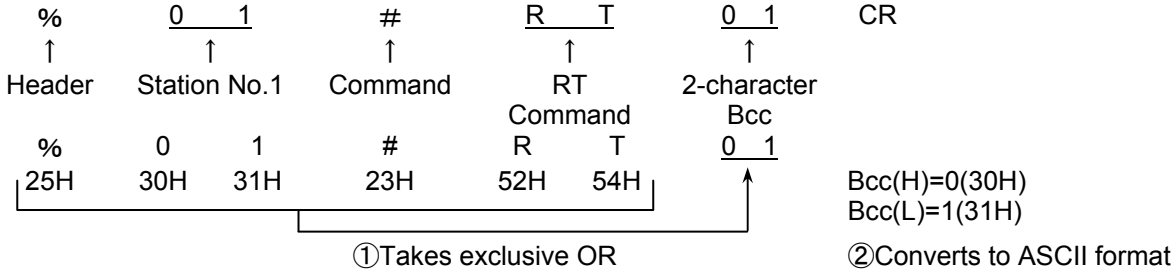
These indicate the content if an error occurs.

◆Bcc（Block Check Code）

-The Bcc is a code that carries out an error check using horizontal parity, to improve the reliability of the data being sent.

-The Bcc uses an exclusive OR from the header (%) to the final character of the text, and converts the 8- bit data into a 2-character ASCII code.

Example)



6.3.2 Data Register List

Data register	Name	Unit	Kind of data	Range	R/W
DT00050	RS485 Device number	—	Unsigned 16bit	Mewtocol: 1 to 99 Modbus: 1 to 247 DL/T645: 0 to 9999	R/W
DT00051	RS485 Transmission speed	—	Unsigned 16bit	0: 1200 1: 2400 2: 4800 3: 9600 4: 19200 5: 38400	R/W
DT00052	RS485 Transmission format	—	Unsigned 16bit	0: 8bit-o 1: 8bit-n 2: 8bit-E	R/W
DT00053	RS485 Stop bit	—	Unsigned 16bit	1, 2	R/W
DT00054	RS485 Response time	1ms	Unsigned 16bit	1 to 99	R/W
DT00055	Phase/Wire	—	Unsigned 16bit	0: 1P2W 1: 1P3W 2: 3P3W 3: 3P4W	R/W
DT00056	CT type (2^{nd})	Rated A (rms)	Unsigned 16bit	1, 5	R/W
DT00057	Primary side current of CT	1A	Unsigned 16bit	1 to 4000	R/W
DT00058	VT ratio	0.01	Unsigned 16bit	100 to 60000	R/W
DT00059	Temperature correction value	0.1℃	Signed 16bit	-100.0 to 100.0	R/W
DT00070	Auto-off	1min	Unsigned 16bit	0 to 99 (0: always ON)	R/W
DT00087	Conversion rate (-P)	0.01	Unsigned 16bit	0 to 9999	R/W
DT00093	Conversion rate (P)	0.01	Unsigned 16bit	0 to 9999	R/W
DT00094	Password	—	Unsigned 16bit	0 to 9999	R/W
DT00095	Auto display start	1min	Unsigned 16bit	0 to 99 (0: fix display item)	R/W
DT00096	Display cycle	1sec	Unsigned 16bit	1 to 99	R/W
DT00097	Luminance	—	Unsigned 16bit	1 to 5 (dark to light)	R/W
DT00098	Protocol	—	Unsigned 16bit	0: MEWTOCOL 1: MODBUS 2: DL/T645	R/W

Data register	Name	Unit	Kind of data	Range	R/W
DT00100 DT00101	Integral active power (1)	0.01kWh	Unsigned 32bit	0 to 999999999	R/W
DT00102 DT00103	Integral active power (2)	0.01kWh	Unsigned 32bit	0 to 999999999	R/W
DT00104 DT00105	Integral active power (3)	0.01kWh	Unsigned 32bit	0 to 999999999	R/W
DT00106 DT00107	Total integral active power	0.01kWh	Unsigned 32bit	0 to 2999999997	R
DT00108 DT00109	Integral reactive power (1)	0.01kvarh	Unsigned 32bit	0 to 999999999	R/W
DT00110 DT00111	Integral reactive power (2)	0.01kvarh	Unsigned 32bit	0 to 999999999	R/W
DT00112 DT00113	Integral reactive power (3)	0.01kvarh	Unsigned 32bit	0 to 999999999	R/W
DT00114 DT00115	Total integral reactive power	0.01kvarh	Unsigned 32bit	0 to 2999999997	R
DT00116 DT00117	Integral apparent power (1)	0.01kVAh	Unsigned 32bit	0 to 999999999	R/W
DT00118 DT00119	Integral apparent power (2)	0.01kVAh	Unsigned 32bit	0 to 999999999	R/W
DT00120 DT00121	Integral apparent power (3)	0.01kVAh	Unsigned 32bit	0 to 999999999	R/W
DT00122 DT00123	Total integral apparent power	0.01kVAh	Unsigned 32bit	0 to 2999999997	R
DT00124 DT00125	Integral export active power (1)	0.01kWh	Unsigned 32bit	0 to 999999999	R/W
DT00126 DT00127	Integral export active power (2)	0.01kWh	Unsigned 32bit	0 to 999999999	R/W
DT00128 DT00129	Integral export active power (3)	0.01kWh	Unsigned 32bit	0 to 999999999	R/W
DT00130 DT00131	Total integral export active power	0.01kWh	Unsigned 32bit	0 to 2999999997	R
DT00132 DT00133	Integral export reactive power (1)	0.01kvarh	Unsigned 32bit	0 to 999999999	R/W
DT00134 DT00135	Integral export reactive power (2)	0.01kvarh	Unsigned 32bit	0 to 999999999	R/W
DT00136 DT00137	Integral export reactive power (3)	0.01kvarh	Unsigned 32bit	0 to 999999999	R/W
DT00138 DT00139	Total integral export reactive power	0.01kvarh	Unsigned 32bit	0 to 2999999997	R
DT00140 DT00141	Instantaneous active power (1)	0.01kW	Signed 32bit	-99999999 to 99999999	R
DT00142 DT00143	Instantaneous active power (2)	0.01kW	Signed 32bit	-99999999 to 99999999	R
DT00144 DT00145	Instantaneous active power (3)	0.01kW	Signed 32bit	-99999999 to 99999999	R
DT00146 DT00147	Total instantaneous active power	0.01kW	Signed 32bit	-299999997 to 299999997	R
DT00148 DT00149	Instantaneous reactive power (1)	0.01kvar	Signed 32bit	-99999999 to 99999999	R
DT00150 DT00151	Instantaneous reactive power (2)	0.01kvar	Signed 32bit	-99999999 to 99999999	R
DT00152 DT00153	Instantaneous reactive power (3)	0.01kvar	Signed 32bit	-99999999 to 99999999	R
DT00154 DT00155	Total instantaneous reactive power	0.01kvar	Signed 32bit	-299999997 to 299999997	R
DT00156 DT00157	Instantaneous apparent power (1)	0.01kVA	Unsigned 32bit	0 to 99999999	R
DT00158 DT00159	Instantaneous apparent power (2)	0.01kVA	Unsigned 32bit	0 to 99999999	R
DT00160 DT00161	Instantaneous apparent power (3)	0.01kVA	Unsigned 32bit	0 to 99999999	R
DT00162 DT00163	Total instantaneous apparent power	0.01kVA	Unsigned 32bit	0 to 299999997	R

Data register	Name	Unit	Kind of data	Range	R/W
DT00164 DT00165	Voltage 1	0.1V	Unsigned 32bit	0 to 999999999	R
DT00166 DT00167	Voltage 2	0.1V	Unsigned 32bit	0 to 999999999	R
DT00168 DT00169	Voltage 3	0.1V	Unsigned 32bit	0 to 999999999	R
DT00170 DT00171	Voltage average	0.1V	Unsigned 32bit	0 to 999999999	R
DT00172 DT00173	Line voltage 1-2	0.1V	Unsigned 32bit	0 to 999999999	R
DT00174 DT00175	Line voltage 2-3	0.1V	Unsigned 32bit	0 to 999999999	R
DT00176 DT00177	Line voltage 3-1	0.1V	Unsigned 32bit	0 to 999999999	R
DT00178 DT00179	Line voltage average	0.1V	Unsigned 32bit	0 to 999999999	R
DT00180 DT00181	Current (1)	0.01A	Unsigned 32bit	0 to 999999999	R
DT00182 DT00183	Current (2)	0.01A	Unsigned 32bit	0 to 999999999	R
DT00184 DT00185	Current (3)	0.01A	Unsigned 32bit	0 to 999999999	R
DT00188 DT00189	Current average	0.01A	Unsigned 32bit	0 to 999999999	R
DT00190	Frequency (1)	0.1Hz	Unsigned 16bit	0 to 1000	R
DT00191	Frequency (2)	0.1Hz	Unsigned 16bit	0 to 1000	R
DT00192	Frequency (3)	0.1Hz	Unsigned 16bit	0 to 1000	R
DT00193	Frequency average	0.1Hz	Unsigned 16bit	0 to 1000	R
DT00194	PF (1)	0.001	Signed 16bit	-1000 to 1000	R
DT00195	PF (2)	0.001	Signed 16bit	-1000 to 1000	R
DT00196	PF (3)	0.001	Signed 16bit	-1000 to 1000	R
DT00197	PF average	0.001	Signed 16bit	-1000 to 1000	R
DT00198 DT00199	Integral active power (1)	0.001 kWh	Unsigned 32bit	0 to 999999999	R/W
DT00200 DT00201	Integral active power (2)	0.001 kWh	Unsigned 32bit	0 to 999999999	R/W
DT00202 DT00203	Integral active power (3)	0.001 kWh	Unsigned 32bit	0 to 999999999	R/W
DT00204 DT00205	Total integral active power	0.001 kWh	Unsigned 32bit	0 to 2999999997	R
DT00206 DT00207	Integral reactive power (1)	0.001 kvarh	Unsigned 32bit	0 to 999999999	R/W
DT00208 DT00209	Integral reactive power (2)	0.001 kvarh	Unsigned 32bit	0 to 999999999	R/W
DT00210 DT00211	Integral reactive power (3)	0.001 kvarh	Unsigned 32bit	0 to 999999999	R/W
DT00212 DT00213	Total integral reactive power	0.001 kvarh	Unsigned 32bit	0 to 2999999997	R
DT00214 DT00215	Integral apparent power (1)	0.001 kVAh	Unsigned 32bit	0 to 999999999	R/W
DT00216 DT00217	Integral apparent power (2)	0.001 kVAh	Unsigned 32bit	0 to 999999999	R/W
DT00218 DT00219	Integral apparent power (3)	0.001 kVAh	Unsigned 32bit	0 to 999999999	R/W
DT00220 DT00221	Total integral apparent power	0.001 kVAh	Unsigned 32bit	0 to 2999999997	R
DT00222 DT00223	Integral export active power (1)	0.001 kWh	Unsigned 32bit	0 to 999999999	R/W
DT00224 DT00225	Integral export active power (2)	0.001 kWh	Unsigned 32bit	0 to 999999999	R/W
DT00226 DT00227	Integral export active power (3)	0.001 kWh	Unsigned 32bit	0 to 999999999	R/W
DT00228 DT00229	Total integral export active power	0.001 kWh	Unsigned 32bit	0 to 2999999997	R

Data register	Name	Unit	Kind of data	Range	R/W
DT00230 DT00231	Integral export reactive power (1)	0.001 kvarh	Unsigned 32bit	0 to 999999999	R/W
DT00232 DT00233	Integral export reactive power (2)	0.001 kvarh	Unsigned 32bit	0 to 999999999	R/W
DT00234 DT00235	Integral export reactive power (3)	0.001 kvarh	Unsigned 32bit	0 to 999999999	R/W
DT00236 DT00237	Total integral export reactive power	0.001 kvarh	Unsigned 32bit	0 to 2999999997	R
DT00238 DT00239	Instantaneous active power (1)	0.001 kW	Signed 32bit	-99999999 to 99999999	R
DT00240 DT00241	Instantaneous active power (2)	0.001 kW	Signed 32bit	-99999999 to 99999999	R
DT00242 DT00243	Instantaneous active power (3)	0.001 kW	Signed 32bit	-99999999 to 99999999	R
DT00244 DT00245	Total instantaneous active power	0.001 kW	Signed 32bit	-299999997 to 299999997	R
DT00246 DT00247	Instantaneous reactive power (1)	0.001 kvar	Signed 32bit	-99999999 to 99999999	R
DT00248 DT00249	Instantaneous reactive power (2)	0.001 kvar	Signed 32bit	-99999999 to 99999999	R
DT00250 DT00251	Instantaneous reactive power (3)	0.001 kvar	Signed 32bit	-99999999 to 99999999	R
DT00252 DT00253	Total instantaneous reactive power	0.001 Kvar	Signed 32bit	-299999997 to 299999997	R
DT00254 DT00255	Instantaneous apparent power (1)	0.001 kVA	Unsigned 32bit	0 to 99999999	R
DT00256 DT00257	Instantaneous apparent power (2)	0.001 kVA	Unsigned 32bit	0 to 99999999	R
DT00258 DT00259	Instantaneous apparent power (3)	0.001 kVA	Unsigned 32bit	0 to 99999999	R
DT00260 DT00261	Total instantaneous apparent power	0.001 kVA	Unsigned 32bit	0 to 299999997	R
DT00262 DT00263	Voltage 1	0.01V	Unsigned 32bit	0 to 999999999	R
DT00264 DT00265	Voltage 2	0.01V	Unsigned 32bit	0 to 999999999	R
DT00266 DT00267	Voltage 3	0.01V	Unsigned 32bit	0 to 999999999	R
DT00268 DT00269	Voltage average	0.01V	Unsigned 32bit	0 to 999999999	R
DT00270 DT00271	Line voltage 1-2	0.01V	Unsigned 32bit	0 to 999999999	R
DT00272 DT00273	Line voltage 2-3	0.01V	Unsigned 32bit	0 to 999999999	R
DT00274 DT00275	Line voltage 3-1	0.01V	Unsigned 32bit	0 to 999999999	R
DT00276 DT00277	Line voltage average	0.01V	Unsigned 32bit	0 to 999999999	R
DT00278 DT00279	Current (1)	0.001A	Unsigned 32bit	0 to 999999999	R
DT00280 DT00281	Current (2)	0.001A	Unsigned 32bit	0 to 999999999	R
DT00282 DT00283	Current (3)	0.001A	Unsigned 32bit	0 to 999999999	R
DT00286 DT00287	Current average	0.001A	Unsigned 32bit	0 to 999999999	R
DT00288	Frequency (1)	0.01Hz	Unsigned 16bit	0 to 10000	R
DT00289	Frequency (2)	0.01Hz	Unsigned 16bit	0 to 10000	R
DT00290	Frequency (3)	0.01Hz	Unsigned 16bit	0 to 10000	R
DT00291	Frequency average	0.01Hz	Unsigned 16bit	0 to 10000	R
DT00418	Temperature	0.1℃	Signed 16bit	-1000 to 1000	R

Data register	Name	Unit	Kind of data	Range	R/W
DT05040 DT05041	Export power conversion value (1)	0.01	Unsigned 32bit	0 to 999999999	R
DT05042 DT05043	Export power conversion value (2)	0.01	Unsigned 32bit	0 to 999999999	R
DT05044 DT05045	Export power conversion value (3)	0.01	Unsigned 32bit	0 to 999999999	R
DT05046 DT05047	Total export power conversion value	0.01	Unsigned 32bit	0 to 2999999997	R
DT05090 DT05091	Conversion value (1)	0.01	Unsigned 32bit	0 to 999999999	R
DT05092 DT05093	Conversion value (2)	0.01	Unsigned 32bit	0 to 999999999	R
DT05094 DT05095	Conversion value (3)	0.01	Unsigned 32bit	0 to 999999999	R
DT05096 DT05097	Total conversion value	0.01	Unsigned 32bit	0 to 2999999997	R

* 'Range' is not the measurement range, it shows the data range.

Note1) R: Read W: Write
2) Data register except specified is 0.
3) If each setting value is wrote by communication, it memories to internal EEP-ROM at the same time. Therefore, change setting frequently makes EEP-ROM's life short. Avoid to usage like this.
4) Write a data within the range when you write it.

6.3.3 Error Codes

◇Basic procedure errors

Error code	Error name	Explanation
40H	Bcc error	・A Bcc error occurred in the command data.
41H	Format error	・A command message was sent that does not fit the transmission format.
42H	No support error	・A command was sent that is not supported.
43H	Procedure error	・Delimiter with multiple frames was sent. ・The response shall be multiple frames.

◇Application error

Error code	Error name	Explanation
60H	Parameter error	・The data code is not "D".
61H	Data error	・Word No. is specified without decimal.（0000F etc.） ・The starting word No. is bigger than the ending word No. ・Writing data has a code that is not hexadecimal.
62H	Registration error	・Too many registrations have been entered (more than 17). ・"MD" command was sent when some registration has been exist. ・"MG" command was sent when registration has not been entered.

◇Self-diagnostic error

Error code	Error name	Explanation
45H	Operation error	・At "WD" command, writing data is exceeded the range of data register.

6.3.4 Command

Eco-POWER METER has 5 kinds of commands.

Command name	Code	Explanation
Read data area	RD	Reads the contents of data area.
Write data to data area	WD	Writes data to a data area.
Resister or Reset data monitored	MD	Resisters the data to be monitored.
Monitoring start	MG	Monitors a registered data.
Read status	RT	Reads the specifications of Eco-POWER METER and error code if an error occurs.

◆[RD]: Read data area (Reads the contents of data area.)

◇Command

%	Destination ×10¹ ×10⁰	#	R	D	D	Starting word No. 5 characters ×10⁴ ×10³ ×10² ×10¹ ×10⁰	Ending word No. 5 characters ×10⁴ ×10³ ×10² ×10¹ ×10⁰	Bcc ×16¹ ×16⁰	CR

◇Normal response (Read successful)

%	Source ×10¹ ×10⁰	$	R	D	First register contents 4 characters ×16¹ ×16⁰ ×16³ ×16²	Last register contents 4 characters ×16¹ ×16⁰ ×16³ ×16²	Bcc ×16¹ ×16⁰	CR

(lower word) (higher word) (lower word) (higher word)

◇Error response

%	Source ×10¹ ×10⁰	!	Error code ×16¹ ×16⁰	Bcc ×16¹ ×16⁰	CR

(Common to each command)

◆[WD]: Write data area (Writes date to a data area.)

◇Command

%	Destination ×10¹ ×10⁰	#	W	D	D	Starting word No. 5 characters ×10⁴ ×10³ ×10² ×10¹ ×10⁰	Ending word No. 5 characters ×10⁴ ×10³ ×10² ×10¹ ×10⁰	First writing data 4 characters ×16¹ ×16⁰ ×16³ ×16²	⇒

(lower word) (higher word)

◇Normal response (Write successful)

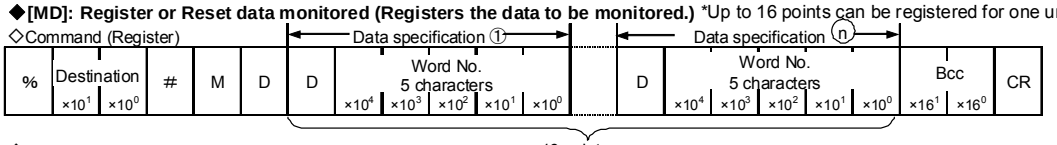
%	Source ×10¹ ×10⁰	$	W	D	Bcc ×16¹ ×16⁰	CR

⇒ Last writing data 4 characters ×16¹ ×16⁰ ×16³ ×16² | Bcc ×16¹ ×16⁰ | CR

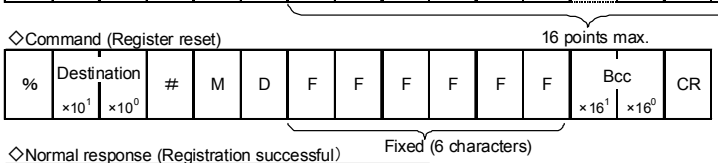
(lower word) (higher word)

◆[MD]: Register or Reset data monitored (Registers the data to be monitored.) *Up to 16 points can be registered for one unit.

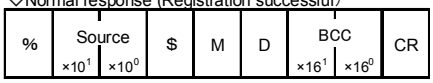
◇Command (Register)


Data specification ①
Data specification n
% Destination ×10¹ ×10⁰ # M D D Word No. 5 characters ×10⁴ ×10³ ×10² ×10¹ ×10⁰ D Word No. 5 characters ×10⁴ ×10³ ×10² ×10¹ ×10⁰ Bcc ×16¹ ×16⁰ CR

◇Command (Register reset)

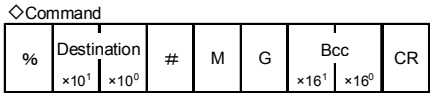


◇Normal response (Registration successful)

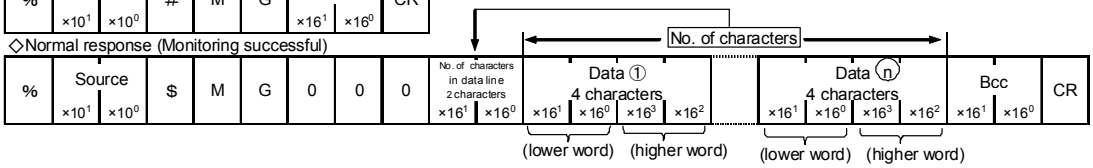


◆[MG]: Monitoring start (Monitors a registered data.)

◇Command



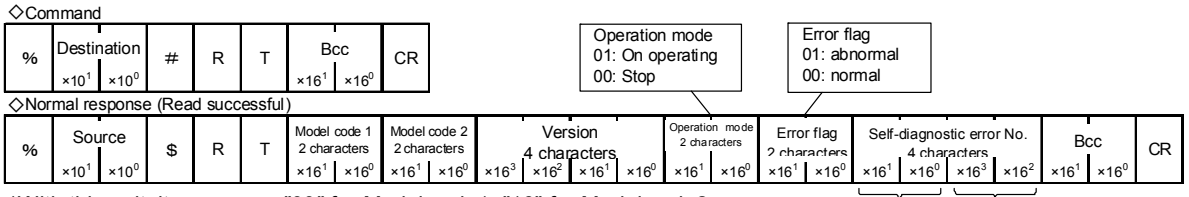
◇Normal response (Monitoring successful)


No. of characters
% Source ×10¹ ×10⁰ $ M G 0 0 0 No. of characters in data line 2 characters ×16¹ ×16⁰ Data ① 4 characters ×16¹ ×16⁰ ×16³ ×16² Data n 4 characters ×16¹ ×16⁰ ×16³ ×16² Bcc ×16¹ ×16⁰ CR
(lower word) (higher word) (lower word) (higher word)

◆[RT]: Read the status of Eco-POWER METER (Reads the specifications of Eco-POWER METER and error codes if an error occurs.)

◇Command

◇Normal response (Read successful)


Operation mode 01: On operating 00: Stop
Error flag 01: abnormal 00: normal
% Source ×10¹ ×10⁰ $ R T Model code 1 2 characters ×16¹ ×16⁰ Model code 2 2 characters ×16¹ ×16⁰ Version 4 characters ×16³ ×16² ×16¹ ×16⁰ Operation mode 2 characters ×16¹ ×16⁰ Error flag 2 characters ×16¹ ×16⁰ Self-diagnostic error No. 4 characters ×16¹ ×16⁰ ×16³ ×16² Bcc ×16¹ ×16⁰ CR
(lower word) (higher word)

*With this unit, it responses "99" for Model code1, "16" for Model code2.

Note) The maximum number of reading slaves is 26 (57 bytes), the maximum number of writing slaves is 23 (55 bytes).

6.4 MODBUS (RTU) Communication

6.4.1 Overview of MODBUS (RTU)

◆8-bit binary data in command is transmitted as it is.

Data format	Start bit	: 1 bit
	Data bit	: 8 bits (Fixed)
	Parity	: No parity, Even parity, Odd parity Selectable
	Stop bit	: 1-bit, 2-bit Selectable
	Error detection	: CRC-16 (Cyclic Redundancy Check)
	Data interval	: 3.5 character transmission time or less

◆Message configuration

RTU mode is configured to start after idle time processing of more than 3.5 character transmissions and end after idle time processing of more than 3.5 character transmissions.

3.5 idle characters	Slave address	Function code	Data	Error check CRC-16	3.5 idle characters
	8-bit	8-bit	xx bits	16-bit	

Master judges the transmission complete after no command for 4-characters idle time and process the command.

*Transmission speed and judgment time to complete transmission

Transmission speed (bps)	Judgment time to complete (ms)
38,400	about 1
19,200	about 2
9,600	about 4
4,800	about 8
2,400	about 16
1,200	About 32

◇Slave address:

Slave address is an individual instrument number on the slave side and is set within the range 1 to 247 (01H to F7H) for Modbus communication. Master identifies slaves by the slave address of the requested message.

Slave informs master which slave is responding to master by placing its own address in the response message. Slave address 0 (00H, broadcast address) can identify all slaves connected. However slaves do not respond.

◇Function code: Function code is command code for the slave to undertake the following action types.

Function code	Contents
03(03H)	DT Read
06(06H)	DT1 word write
16(10H)	DT several data write

Function code is used to discern whether the response is normal (acknowledgement) or if any error (negative acknowledgement) has occurred when slave returns response message to master.

When acknowledgement is returned, slave simply returns original function code. When negative acknowledgement is returned, MSB of original function code is set as 1 for response.

For example, when the master sends request message setting 00H to function code by mistake, slave returns 80H by setting MSB to 1, because the former is an illegal function.

For negative acknowledgement, the exception codes below are set to data of response message and returned to master in order to inform it of what kind of error has occurred.

Exception code	Contents
1(01H)	Illegal Function (Non-existent function)
3(03H)	Illegal data value (Value out of the devise numbers)

note1) Even if it commands to write (06H.10H) to non-existent data address, slave response with acknowledgement. However, it doesn't write.

note2) Even if it commands to write the value out of the setting range, slave response with acknowledgement. However, it doesn't write.

note3) The maximum number of reading slaves is 26 (57-byte), the maximum number of writing slaves is 23 (55-byte).

◇Data: Data depends on the function code.
A request message from the master side is composed of data item, number of data and setting data.
A response message from the slave side is composed of number of bytes, data and exception code in negative acknowledgement.

◇Error check: 16-bit data to detect communication errors. Refer to the next.

◇Acknowledgement response
When command is to write 1 point, same massage of command is responded.
When command is to write several points, part of command message (6-byte) is responded.

◆Error check
After calculating CRC-16 (Cyclic Redundancy Check) from slave address to the end of data, the calculated 16-bit data is appended to the end of message in sequence from low order to high order.
<How to calculate CRC>
In CRC system, the information is divided by the polynomial series. The remainder is added to the end of the information and transmitted. The generation of polynomial series is as follows.
(Generation of polynomial series: $X^{16} + X^{15} + X^{2} + 1$)
1) Initialize the CRC-16 data (assumed as X) (FFFFH).
2) Calculate exclusive OR (XOR) with the 1st data and X. This is assumed as X.
3) Shift X one bit to the right. This is assumed as X.
4) When a carry is generated as a result of the shift, XOR is calculated by X of 3) and the fixed value (A001H). This is assumed as X. If a carry is not generated, go to step 5).
5) Repeat steps 3) and 4) until shifting 8 times.
6) XOR is calculated with the next data and X. This is assumed as X.
7) Repeat steps 3) to 5).
8) Repeat steps 3) to 5) up to the last data.
9) Set X as CRC-16 to the end of message in sequence from low order to high order.

◆Message example
<1> Reading conversion rate (P) (005DH) of address 1
・Command

3.5 idle characters	Slave address (01H)	Function code (03H)	Data item (005DH)	Number of data (0001H)	Error check CRC-16 (15D8H)	3.5 idle characters
	1	1	2	2	2	←character number

・Response message from slave in normal status (When Rate=1000(10.00) [03E8H])

3.5 idle characters	Slave address (01H)	Function code (03H)	Number of response byte (02H)	Number of data (03E8H)	Error check CRC-16 (B8FAH)	3.5 idle characters
	1	1	1	2	2	←character number

<2> Setting conversion rate (P) (005DH) of address 1 (When rate is set to 20.00(2000) [07D0H])
・Command

3.5 idle characters	Slave address (01H)	Function code (06H)	Data item (005DH)	Number of data (07D0H)	Error check CRC-16 (1BB4H)	3.5 idle characters
	1	1	2	2	2	←character number

・Response message from slave in normal status

3.5 idle characters	Slave address (01H)	Function code (06H)	Data item (005DH)	Number of data (07D0H)	Error check CRC-16 (1BB4H)	3.5 idle characters
	1	1	2	2	2	←character number

<3> Reset integral active power (0064H, 0065H: 2-word) of address 1

(When setting to 0 [0000, 0000H])

・Command

3.5 idle characters	Slave address (01H)	Function code (10H)	Data item (0064H)	Number of data item to write (0002H)	Number of data (04H)	⇒
	1	1	2	2	1	←character number

⇒	Data 1 (0000H)	Data 2 (0000H)	Error check CRC-16 (F474H)	3.5 idle characters
	2	2	2	←character number

・Response message from slave in normal status

3.5 idle characters	Slave address (01H)	Function code (10H)	Data item (0064H)	Number of data item to write (0002H)	Error check CRC-16 (0017H)	3.5 idle characters
	1	1	2	2	2	←character number

・A response message from the slave in exception (error) status

(When number of data has been mistaken.)

Function code MSB is set to 1 for the response message in exception (error) status (90H).
The exception code 03H (Value out of the devise numbers) is returned as contents of error.

<Mistaken message example (Command)>

3.5 idle characters	Slave address (01H)	Function code (10H)	Number of data item to write (0002H)	Number of data ***(06H)***	⇒

↑ **Mistake**

⇒	Data 1 (0000H)	Data 2 (0000H)	Error check CRC-16 (8F8E)	3.5 idle characters

<Response message from slave to mistaken command
(Response message in exception (error) status)>

3.5 idle characters	Slave address (01H)	Function code (90H)	Exception code (03H)	Error check CRC-16 (0C01H)	3.5 idle characters

6.4.2 Data Register List (MODBUS communication)

Data register	Name	Unit	Kind of data	Range: Hexadecimal	Function code
0032H	RS485 Device number	—	Unsigned 16bit	Mewtocol: 1H to 64H Modbus: 1H to F7H DL/T645: 0H to 270FH	03H/ 06H/10H
0033H	RS485 Transmission speed	—	Unsigned 16bit	0H: 1200 1H: 2400 2H: 4800 3H: 9600 4H: 19200 5H: 38400	03H/ 06H/10H
0034H	RS485 Transmission format	—	Unsigned 16bit	0H: 8bit-o 1H: 8bit-n 2H: 8bit-E	03H/ 06H/10H
0035H	RS485 Stop bit	—	Unsigned 16bit	1H, 2H	03H/ 06H/10H
0036H	RS485 Response time	1ms	Unsigned 16bit	1H to 63H	03H/ 06H/10H
0037H	Phase/Wire	—	Unsigned 16bit	0H: 1P2W 1H: 1P3W 2H: 3P3W 3H: 3P4W	03H/ 06H/10H
0038H	CT type (2^{nd})	Rated A (rms)	Unsigned 16bit	1H, 5H	03H/ 06H/10H
0039H	Primary side current of CT	1A	Unsigned 16bit	1H to FA0H	03H/ 06H/10H
003AH	VT ratio	0.01	Unsigned 16bit	64H to EA60H	03H/ 06H/10H
003BH	Temperature correction value	0.1℃	Signed 16bit	FC18H to 3E8H	03H/ 06H/10H
0046H	Auto-off	1min	Unsigned 16bit	0H to 63H (0H: always ON)	03H/ 06H/10H
0057H	Conversion rate (-P)	0.01	Unsigned 16bit	0H to 270FH	03H/ 06H/10H
005DH	Conversion rate (P)	0.01	Unsigned 16bit	0H to 270FH	03H/ 06H/10H
005EH	Password	—	Unsigned 16bit	0H to 270FH	03H/ 06H/10H
005FH	Auto display start	1min	Unsigned 16bit	0H to 63H (0H: fix display item)	03H/ 06H/10H
0060H	Display cycle	1sec	Unsigned 16bit	1H to 63H	03H/ 06H/10H
0061H	Luminance	—	Unsigned 16bit	1H to 5H	03H/ 06H/10H
0062H	Protocol	—	Unsigned 16bit	0: MEWTOCOL 1: MODBUS 2: DL/T645	03H/ 06H/10H

* ’Range’ is not the measurement range, it shows the data range.

Data register	Name	Unit	Kind of data	Range: Hexadecimal	Function code
0064H <LSB> 0065H <MSB>	Integral active power (1)	0.01kWh	Unsigned 32bit	0H to 3B9AC9FFH	03H/10H
0066H <LSB> 0067H <MSB>	Integral active power (2)	0.01kWh	Unsigned 32bit	0H to 3B9AC9FFH	03H/10H
0068H <LSB> 0069H <MSB>	Integral active power (3)	0.01kWh	Unsigned 32bit	0H to 3B9AC9FFH	03H/10H
006AH <LSB> 006BH <MSB>	Total integral active power	0.01kWh	Unsigned 32bit	0H to B2D05DFDH	03H
006CH <LSB> 006DH <MSB>	Integral reactive power (1)	0.01kvarh	Unsigned 32bit	0H to 3B9AC9FFH	03H/10H
006EH <LSB> 006FH <MSB>	Integral reactive power (2)	0.01kvarh	Unsigned 32bit	0H to 3B9AC9FFH	03H/10H
0070H <LSB> 0071H <MSB>	Integral reactive power (3)	0.01kvarh	Unsigned 32bit	0H to 3B9AC9FFH	03H/10H
0072H <LSB> 0073H <MSB>	Total integral reactive power	0.01kvarh	Unsigned 32bit	0H to B2D05DFDH	03H
0074H <LSB> 0075H <MSB>	Integral apparent power (1)	0.01kVAh	Unsigned 32bit	0H to 3B9AC9FFH	03H/10H
0076H <LSB> 0077H <MSB>	Integral apparent power (2)	0.01kVAh	Unsigned 32bit	0H to 3B9AC9FFH	03H/10H
0078H <LSB> 0079H <MSB>	Integral apparent power (3)	0.01kVAh	Unsigned 32bit	0H to 3B9AC9FFH	03H/10H
007AH <LSB> 007BH <MSB>	Total integral apparent power	0.01kVAh	Unsigned 32bit	0H to B2D05DFDH	03H
007CH <LSB> 007DH <MSB>	Integral export active power (1)	0.01kWh	Unsigned 32bit	0H to 3B9AC9FFH	03H/10H
007EH <LSB> 007FH <MSB>	Integral export active power (2)	0.01kWh	Unsigned 32bit	0H to 3B9AC9FFH	03H/10H
0080H <LSB> 0081H <MSB>	Integral export active power (3)	0.01kWh	Unsigned 32bit	0H to 3B9AC9FFH	03H/10H
0082H <LSB> 0083H <MSB>	Total integral export active power	0.01kWh	Unsigned 32bit	0H to B2D05DFDH	03H
0084H <LSB> 0085H <MSB>	Integral export reactive power (1)	0.01kvarh	Unsigned 32bit	0H to 3B9AC9FFH	03H/10H
0086H <LSB> 0087H <MSB>	Integral export reactive power (2)	0.01kvarh	Unsigned 32bit	0H to 3B9AC9FFH	03H/10H
0088H <LSB> 0089H <MSB>	Integral export reactive power (3)	0.01kvarh	Unsigned 32bit	0H to 3B9AC9FFH	03H/10H
008AH <LSB> 008BH <MSB>	Total integral export reactive power	0.01kvarh	Unsigned 32bit	0H to B2D05DFDH	03H

* ’Range’ is not the measurement range, it shows the data range.

Data register	Name	Unit	Kind of data	Range: Hexadecimal	Function code
008CH <LSB> 008DH <MSB>	Instantaneous active power (1)	0.01kW	Signed 32bit	FA0A1F01H to 5F5E0FFH	03H
008EH <LSB> 008FH <MSB>	Instantaneous active power (2)	0.01kW	Signed 32bit	FA0A1F01H to 5F5E0FFH	03H
0090H <LSB> 0091H <MSB>	Instantaneous active power (3)	0.01kW	Signed 32bit	FA0A1F01H to 5F5E0FFH	03H
0092H <LSB> 0093H <MSB>	Total instantaneous active power	0.01kW	Signed 32bit	EE1E5D03H to 11E1A2FDH	03H
0094H <LSB> 0095H <MSB>	Instantaneous reactive power (1)	0.01kvar	Signed 32bit	FA0A1F01H to 5F5E0FFH	03H
0096H <LSB> 0097H <MSB>	Instantaneous reactive power (2)	0.01kvar	Signed 32bit	FA0A1F01H to 5F5E0FFH	03H
0098H <LSB> 0099H <MSB>	Instantaneous reactive power (3)	0.01kvar	Signed 32bit	FA0A1F01H to 5F5E0FFH	03H
009AH <LSB> 009BH <MSB>	Total instantaneous reactive power	0.01kvar	Signed 32bit	EE1E5D03H to 11E1A2FDH	03H
009CH <LSB> 009DH <MSB>	Instantaneous apparent power (1)	0.01kVA	Unsigned 32bit	0H to 5F5E0FFH	03H
009EH <LSB> 009FH <MSB>	Instantaneous apparent power (2)	0.01kVA	Unsigned 32bit	0H to 5F5E0FFH	03H
00A0H <LSB> 00A1H <MSB>	Instantaneous apparent power (3)	0.01kVA	Unsigned 32bit	0H to 5F5E0FFH	03H
00A2H <LSB> 00A3H <MSB>	Total instantaneous apparent power	0.01kVA	Unsigned 32bit	0H to 11E1A2FDH	03H
00A4H <LSB> 00A5H <MSB>	Voltage 1	0.1V	Unsigned 32bit	0H to 3B9AC9FFH	03H
00A6H <LSB> 00A7H <MSB>	Voltage 2	0.1V	Unsigned 32bit	0H to 3B9AC9FFH	03H
00A8H <LSB> 00A9H <MSB>	Voltage 3	0.1V	Unsigned 32bit	0H to 3B9AC9FFH	03H
00AAH <LSB> 00ABH <MSB>	Voltage average	0.1V	Unsigned 32bit	0H to 3B9AC9FFH	03H
00ACH <LSB> 00ADH <MSB>	Line voltage 1-2	0.1V	Unsigned 32bit	0H to 3B9AC9FFH	03H
00AEH <LSB> 00AFH <MSB>	Line voltage 2-3	0.1V	Unsigned 32bit	0H to 3B9AC9FFH	03H
00B0H <LSB> 00B1H <MSB>	Line voltage 3-1	0.1V	Unsigned 32bit	0H to 3B9AC9FFH	03H
00B2H <LSB> 00B3H <MSB>	Line voltage average	0.1V	Unsigned 32bit	0H to 3B9AC9FFH	03H
00B4H <LSB> 00B5H <MSB>	Current (1)	0.01A	Unsigned 32bit	0H to 3B9AC9FFH	03H
00B6H <LSB> 00B7H <MSB>	Current (2)	0.01A	Unsigned 32bit	0H to 3B9AC9FFH	03H
00B8H <LSB> 00B9H <MSB>	Current (3)	0.01A	Unsigned 32bit	0H to 3B9AC9FFH	03H
00BCH <LSB> 00BDH <MSB>	Current average	0.01A	Unsigned 32bit	0H to 3B9AC9FFH	03H
00BEH	Frequency (1)	0.1Hz	Unsigned 16bit	0H to 3E8H	03H
00BFH	Frequency (2)	0.1Hz	Unsigned 16bit	0H to 3E8H	03H
00C0H	Frequency (3)	0.1Hz	Unsigned 16bit	0H to 3E8H	03H
00C1H	Frequency average	0.1Hz	Unsigned 16bit	0H to 3E8H	03H
00C2H	PF (1)	0.001	Signed 16bit	FC18H to 3E8H	03H
00C3H	PF (2)	0.001	Signed 16bit	FC18H to 3E8H	03H
00C4H	PF (3)	0.001	Signed 16bit	FC18H to 3E8H	03H
00C5H	PF average	0.001	Signed 16bit	FC18H to 3E8H	03H

* ’Range’ is not the measurement range, it shows the data range.

Data register	Name	Unit	Kind of data	Range: Hexadecimal	Function code
00C6H <LSB> 00C7H <MSB>	Integral active power (1)	0.001 kWh	Unsigned 32bit	0H to 3B9AC9FFH	03H/10H
00C8H <LSB> 00C9H <MSB>	Integral active power (2)	0.001 kWh	Unsigned 32bit	0H to 3B9AC9FFH	03H/10H
00CAH <LSB> 00CBH <MSB>	Integral active power (3)	0.001 kWh	Unsigned 32bit	0H to 3B9AC9FFH	03H/10H
00CCH <LSB> 00CDH <MSB>	Total integral active power	0.001 kWh	Unsigned 32bit	0H to B2D05DFDH	03H
00CEH <LSB> 00CFH <MSB>	Integral reactive power (1)	0.001 kvarh	Unsigned 32bit	0H to 3B9AC9FFH	03H/10H
00D0H <LSB> 00D1H <MSB>	Integral reactive power (2)	0.001 kvarh	Unsigned 32bit	0H to 3B9AC9FFH	03H/10H
00D2H <LSB> 00D3H <MSB>	Integral reactive power (3)	0.001 kvarh	Unsigned 32bit	0H to 3B9AC9FFH	03H/10H
00D4H <LSB> 00D5H <MSB>	Total integral reactive power	0.001 kvarh	Unsigned 32bit	0H to B2D05DFDH	03H
00D6H <LSB> 00D7H <MSB>	Integral apparent power (1)	0.001 kVAh	Unsigned 32bit	0H to 3B9AC9FFH	03H/10H
00D8H <LSB> 00D9H <MSB>	Integral apparent power (2)	0.001 kVAh	Unsigned 32bit	0H to 3B9AC9FFH	03H/10H
00DAH <LSB> 00DBH <MSB>	Integral apparent power (3)	0.001 kVAh	Unsigned 32bit	0H to 3B9AC9FFH	03H/10H
00DCH <LSB> 00DDH <MSB>	Total integral apparent power	0.001 kVAh	Unsigned 32bit	0H to B2D05DFDH	03H
00DEH <LSB> 00DFH <MSB>	Integral export active power (1)	0.001 kWh	Unsigned 32bit	0H to 3B9AC9FFH	03H/10H
00E0H <LSB> 00E1H <MSB>	Integral export active power (2)	0.001 kWh	Unsigned 32bit	0H to 3B9AC9FFH	03H/10H
00E2H <LSB> 00E3H <MSB>	Integral export active power (3)	0.001 kWh	Unsigned 32bit	0H to 3B9AC9FFH	03H/10H
00E4H <LSB> 00E5H <MSB>	Total integral export active power	0.001 kWh	Unsigned 32bit	0H to B2D05DFDH	03H
00E6H <LSB> 00E7H <MSB>	Integral export reactive power (1)	0.001 kvarh	Unsigned 32bit	0H to 3B9AC9FFH	03H/10H
00E8H <LSB> 00E9H <MSB>	Integral export reactive power (2)	0.001 kvarh	Unsigned 32bit	0H to 3B9AC9FFH	03H/10H
00EAH <LSB> 00EBH <MSB>	Integral export reactive power (3)	0.001 kvarh	Unsigned 32bit	0H to 3B9AC9FFH	03H/10H
00ECH <LSB> 00EDH <MSB>	Total integral export reactive power	0.001 kvarh	Unsigned 32bit	0H to B2D05DFDH	03H
00EEH <LSB> 00EFH <MSB>	Instantaneous active power (1)	0.001 kW	Signed 32bit	FA0A1F01H to 5F5E0FFH	03H
00F0H <LSB> 00F1H <MSB>	Instantaneous active power (2)	0.001 kW	Signed 32bit	FA0A1F01H to 5F5E0FFH	03H
00F2H <LSB> 00F3H <MSB>	Instantaneous active power (3)	0.001 kW	Signed 32bit	FA0A1F01H to 5F5E0FFH	03H
00F4H <LSB> 00F5H <MSB>	Total instantaneous active power	0.001 kW	Signed 32bit	EE1E5D03H to 11E1A2FDH	03H
00F6H <LSB> 00F7H <MSB>	Instantaneous reactive power (1)	0.001 kvar	Signed 32bit	FA0A1F01H to 5F5E0FFH	03H
00F8H <LSB> 00F9H <MSB>	Instantaneous reactive power (2)	0.001 kvar	Signed 32bit	FA0A1F01H to 5F5E0FFH	03H
00FAH <LSB> 00FBH <MSB>	Instantaneous reactive power (3)	0.001 kvar	Signed 32bit	FA0A1F01H to 5F5E0FFH	03H
00FCH <LSB> 00FDH <MSB>	Total instantaneous reactive power	0.001 kvar	Signed 32bit	EE1E5D03H to 11E1A2FDH	03H

* 'Range' is not the measurement range, it shows the data range.

Data register	Name	Unit	Kind of data	Range: Hexadecimal	Function code
00FEH <LSB> 00FFH <MSB>	Instantaneous apparent power (1)	0.001 kVA	Unsigned 32bit	0H to 5F5E0FFH	03H
0100H <LSB> 0101H <MSB>	Instantaneous apparent power (2)	0.001 kVA	Unsigned 32bit	0H to 5F5E0FFH	03H
0102H <LSB> 0103H <MSB>	Instantaneous apparent power (3)	0.001 kVA	Unsigned 32bit	0H to 5F5E0FFH	03H
0104H <LSB> 0105H <MSB>	Total instantaneous apparent power	0.001 kVA	Unsigned 32bit	0H to 11E1A2FDH	03H
0106H <LSB> 0107H <MSB>	Voltage 1	0.01V	Unsigned 32bit	0H to 3B9AC9FFH	03H
0108H <LSB> 0109H <MSB>	Voltage 2	0.01V	Unsigned 32bit	0H to 3B9AC9FFH	03H
010AH <LSB> 010BH <MSB>	Voltage 3	0.01V	Unsigned 32bit	0H to 3B9AC9FFH	03H
010CH <LSB> 010DH <MSB>	Voltage average	0.01V	Unsigned 32bit	0H to 3B9AC9FFH	03H
010EH <LSB> 010FH <MSB>	Line voltage 1-2	0.01V	Unsigned 32bit	0H to 3B9AC9FFH	03H
0110H <LSB> 0111H <MSB>	Line voltage 2-3	0.01V	Unsigned 32bit	0H to 3B9AC9FFH	03H
0112H <LSB> 0113H <MSB>	Line voltage 3-1	0.01V	Unsigned 32bit	0H to 3B9AC9FFH	03H
0114H <LSB> 0115H <MSB>	Line voltage average	0.01V	Unsigned 32bit	0H to 3B9AC9FFH	03H
0116H <LSB> 0117H <MSB>	Current (1)	0.001A	Unsigned 32bit	0H to 3B9AC9FFH	03H
0118H <LSB> 0119H <MSB>	Current (2)	0.001A	Unsigned 32bit	0H to 3B9AC9FFH	03H
011AH <LSB> 011BH <MSB>	Current (3)	0.001A	Unsigned 32bit	0H to 3B9AC9FFH	03H
011EH <LSB> 011FH <MSB>	Current average	0.001A	Unsigned 32bit	0H to 3B9AC9FFH	03H
0120H	Frequency (1)	0.01Hz	Unsigned 16bit	0H to 2710H	03H
0121H	Frequency (2)	0.01Hz	Unsigned 16bit	0H to 2710H	03H
0122H	Frequency (3)	0.01Hz	Unsigned 16bit	0H to 2710H	03H
0123H	Frequency average	0.01Hz	Unsigned 16bit	0H to 2710H	03H
01A2H	Temperature	0.1℃	Signed 16bit	FC18H to 3E8H	03H
13B0H <LSB> 13B1H <MSB>	Export power conversion value (1)	0.01	Unsigned 32bit	0H to 3B9AC9FFH	03H
13B2H <LSB> 13B3H <MSB>	Export power conversion value (2)	0.01	Unsigned 32bit	0H to 3B9AC9FFH	03H
13B4H <LSB> 13B5H <MSB>	Export power conversion value (3)	0.01	Unsigned 32bit	0H to 3B9AC9FFH	03H
13B6H <LSB> 13B7H <MSB>	Total export power conversion value	0.01	Unsigned 32bit	0H to B2D05DFDH	03H
13E2H <LSB> 13E3H <MSB>	Conversion value (1)	0.01	Unsigned 32bit	0H to 3B9AC9FFH	03H
13E4H <LSB> 13E5H <MSB>	Conversion value (2)	0.01	Unsigned 32bit	0H to 3B9AC9FFH	03H
13E6H <LSB> 13E7H <MSB>	Conversion value (3)	0.01	Unsigned 32bit	0H to 3B9AC9FFH	03H
13E8H <LSB> 13E9H <MSB>	Total conversion value	0.01	Unsigned 32bit	0H to B2D05DFDH	03H

* 'Range' is not the measurement range, it shows the data range.

<LSB>: Least Significant Byte
<MSB>: Most Significant Byte

note 1) 03H: Read 06H/10H: Write
2) Data register except specified is “0”.
3) If each setting value is wrote by communication, it memories to internal EEP-ROM at the same time. Therefore, change setting frequently makes EEP-ROM’s life short. Avoid to usage like this.
4) Write a data within the range when you write it.

6.5 DL/T645-2007 communication

6.5.1 Overview of DL/T645-2007

Only 2007 version of DL/T645 is supported. Other version is not supported.

◆DL/T645-2007 transmission settings are as below.

Transmission format	8bit
Parity	Even (fixed)
Stop bit	1bit (fixed)
Response time	50ms (fixed)
Stop time between byte	500ms or more

◆Frame format

Frame start number	68H
Address field	A0
	A1
	A2
	A3
	A4
	A5
Frame start symbol	68H
Control code	C
Data field length	L
Data field	DATA
Check code	CS
End symbol	16H

Address field (A0 to A5)

Address (device number) is consisted of 6-byte (12-digit), but the range is 0 to 9999.
(When the number of digit is not filled, it fills it up with '0'.)
Transmission address '999999999999H' is not supported.
Address field supports wild card. It fills it up with AA from the lower to upper without any value.
When it transmits address field, it transmits from lower to upper. (A0 A1 A2 A3 A4 A5)

Ex.) In case of that the address is 55H.

・Correct address field

	Transmission format
Without wild card	55 00 00 00 00 00
With wild card	55 00 AA AA AA AA

・Case that is NG with wild card

Address field	Reason
55 00 00 AA 00 AA	There is '00' between 'AA' and 'AA'.
55 00 00 A0 AA AA	A3 of address field is not 'AA'.

Control code (C)

C							
D7	D6	D5	D4	D3	D2	D1	D0
Transmission direction	Slave response flag	Subsequent frame flag	Function code				

Item		Contents
Transmission direction (D7)	0	Command frame from master
	1	Response frame from slave
Slave response flag (D6)	0	Slave response is correct.
	1	Slave response is wrong.
Subsequent frame flag (D5)	0	No subsequent data
	1	With subsequent data
Function code (D4 to D0)	00000	Vacant
	01000	Not support
	10001	Read out data
	10010	Not support
	10011	Read out transmission address (device number)
	10100	Write data
	10101	Write transmission address (device number)
	10110	Not support
	10111	Change transmission speed
	11000	Change password
	11001	Not support
	11010	Reset integral power
	11011	Not support

Data field length (L)

It is byte count of data field.

Read :L≦200, Write: L≦50 L=0 means no data field.

Data field (DATA)

Data field is consisted of ‘data type’, ‘password’, ‘workers code’, ‘frame number’ and so on.

The content differs according to the control code.

When data is transmitted, 33H is added to each byte. When data is received, 33H is subtracted from each byte.

Ex.) Transmission in case of that data identification is ‘04 03 FF 00 (DI3、DI2、DI1、DI0)’

Code	Value	Calculation
DI3	37	= 04 + 33
DI2	36	= 03 + 33
DI1	32	= FF + 33 (FF + 33 equal 132. But it makes1 byte data, 32.)
DI0	33	= 00 + 33

It transmits from the lower, data field is ‘33 32 36 37(DI0 DI1 DI2 DI3)’.

Ex.) In case of the receiving data is ‘45 34 (N1 N0’. (Receive voltage 112V)

Code	Value	Calculation
N1	12	= 45-33
N0	01	= 34-33

It receives from the lower, it is ‘N0 N1’ and the voltage is 112V.

(It receives with hexadecimal but it doesn’t convert the value subtract 33 to decimal.)

Check code (CS)

It is lower 1 byte in total of all byte from frame start symbol to data field.

Ex.) In case of that the transmission command is '68 01 00 00 00 00 00 68 11 04 33 33 34 33 CS 16',
Check code (CS) is as below.
68 + 01 + 00 + 00 + 00 + 00 + 00 + 68 + 11 + 04 + 33 + 33 + 34 + 33 = 1B3
CS = B3 (CS is lower 1 byte.)

End symbol (16H)

There is 16H at the end of frame.

◆Command for each control code

Read out data

Data read out by the data identifications.

・Command from master; Control code 11H

68H	A0	A1	A2	A3	A4	A5	68H	11H	04H	
	Transmission address (A0 to A5 or AAH)							Control code	Data length	⇒ continue

⇒ continue

DI0	DI1	DI2	DI3	CS	16H
Data identification (Add 33H to data identification value)					

・Response from slave (normal)

68H	A0	A1	A2	A3	A4	A5	68H	91H	L	
	Transmission address (A0 to A5)								Data length (Data identification byte +data byte)	⇒ continue

⇒ continue

DI0	DI1	DI2	DI3	N1	・・・	Nm	CS	16H
Data identification (Add 33H to data identification value)				Data (Add 33H to measuring value and setting value)				

Read out transmission address

It read out the transmission address (device number).

It is available only when master and slave is 1:1.

・Command from master; Control code 13H

68H	AAH	AAH	AAH	AAH	AAH	AAH	68H	13H	00H	CS	16H
	Transmission address (AAH fix)							Control code			

・Response from slave (normal)

68H	A0	A1	A2	A3	A4	A5	68H	93H	06H	
	Transmission address read out from slave									⇒ continue

⇒ continue

A0	A1	A2	A3	A4	A5	CS	16H
Transmission address read out from slave							

*No response when slave is abnormal.

Write data

It is available only with pressing <MODE> key (programming key).
Without pressing programming key, it doesn't response.
For data writing, authorization level (PA0) should be designated, but only '0' is supported.
For workers code, it doesn't record and the code is fixed to '0'.

・Command from master; Control code 14H
Data length (L); Byte count of data identification + Byte count of password authorization level + Byte count of password + Byte count of workers code + Byte count of data to write

68H	A0	A1	A2	A3	A4	A5	68H	14H	L
	Transmission address (A0 to A5 or AAH)							Control code	

⇒ continue

⇒ continue

DI0	DI1	DI2	DI3	PA	P0	P1	P2
Data identification				Authorization level (33H fix)	Password (P2:33H fix)		

⇒ continue

⇒ continue

C0	C1	C2	C3	N1	・・・	Nm	CS	16H
Workers code (33H fix)				Writing data				

・Response from slave (normal)

68H	A0	A1	A2	A3	A4	A5	68H	94H	00H	CS	16H

Write transmission address

It writes the transmission address (device number). It is available only when master and slave is 1:1.
Without pressing programming key, it doesn't response.
・Command from master; Control code 15H

68H	AAH	AAH	AAH	AAH	AAH	AAH	68H	15H	06H
	Transmission address (AAH fix)							Control code	

⇒ continue

⇒ continue

A0	A1	A2	A3	A4	A5	CS	16H
Transmission address to write slave (Add 33H to transmission address value)							

・Response from slave (normal)

68H	A0	A1	A2	A3	A4	A5	68H	95H	00H	CS	16H
	New transmission address										

*No response when slave is abnormal.

Change transmission speed

It changes the transmission speed after it returns the response.

・Command from master; Control code 17H

68H	A0	A1	A2	A3	A4	A5	68H	17H	01H	Z	CS	16H
	Transmission address							Control code		Transmission speed (bit flag)		

Transmission speed (bit flag)	bit	Transmission speed [bps]
	Bit 7	38400
	Bit 6	19200
	Bit 5	9600
	Bit 4	4800
	Bit 3	2400
	Bit 2	1200
	Bit 1	空き
	Bit 0	空き

・Response from slave (normal)

68H	A0	A1	A2	A3	A4	A5	68H	97H	01H	Z	CS	16H
	Transmission address									Transmission speed (bit flag)		

Change password

It changes password.

It is available only with pressing <MODE> key (programming key).

Without pressing programming key, it doesn't response.

For changing password, authorization level (PA0) should be designated, but only '0' is supported.

・Command from master; Control code 18H

68H	A0	A1	A2	A3	A4	A5	68H	18H	0CH
	Transmission address							Control code	

⇒ continue

⇒ Continue

DI0	DI1	DI2	DI3	PA	P0	P1	P2
34 3F 33 37 (Add 33H to 01 0C 00 04) (Only "0" is supported.)				Designate authorization level (33H fix)	Designate the present password (P2: 33H fix)		

⇒ continue

⇒ continue

PAn	P0n	P1n	P2n	CS	16H
Authorization level for password to change (33H fix)	New password (P2n: 33H fix)				

・Response from slave (normal)

68H	A0	A1	A2	A3	A4	A5	68H	18H	04H
	Transmission address								

⇒ continue

PAn	P0n	P1n	P2n	CS	16H
Authorization level for changed password (33H fix)	Changed password (P2n: 33H fix)				

Reset integral power

It reset all integral power.

For reset integral power, workers code should be designated, but it doesn't record and the code is fixed to '0'. It is available only with pressing <MODE> key (programming key).

・Command from master; control code 1AH

68H	A0	A1	A2	A3	A4	A5	68H	1AH	08H	⇒
	Transmission address							Control code		continue

⇒ continue	PA		P0	P1	P2	⇒ continue
	Authorization level (33H fix)		Password (P2: 33H fix)			

⇒ continue	C0	C1	C2	C3	CS	16H
	Workers code (33H fix)					

・Response from slave (normal)

68H	A0	A1	A2	A3	A4	A5	68H	9AH	00H	CS	16H

Abnormal command from slave

Control code (C); C0H (Response from slave is abnormal.)
+ Control code when error occurs.

68H	A0	A1	A2	A3	A4	A5	68H	C	01H	ERR	16H
								Control code		Error code (bit flag)	

Contents of error code	Bit flag	Contents
	Bit 7	Not support
	Bit 6	Not support
	Bit 5	Not support
	Bit 4	Not support
	Bit 3	Impossible to change transmission speed
	Bit 2	Password mistake
	Bit 1	No request data
	Bit 0	Other errors

Conditions for no response

With the below conditions, slave doesn't response.

・Parity error
・CS error
・Data length (L) doesn't match byte count.
・Error at write or read of transmission address
・Not press programming key (<MODE> key)

Programming key

Programming key is <MODE> key.

With every display, it is possible to change the settings only when pressing <MODE> key.

6.5.2 Data list

Data identification				Name	Data format	unit	byte	range	R/W
DI_3	DI_2	DI_1	DI_0						
04	05	00	00	Transmission protocol	X	—	1	0:Mewtocol, 1:Modbus 2:DL/T645	R/W
			01	Transmission format	X	—	1	0:8bit-Odd, 1:8bit-None 2:8bit-Even	R/W
			02	Stop bit	X	—	1	1, 2	R/W
			03	Response time	XX	ms	1	1 to 99	R/W
04	05	01	01	CT type (2^{nd})	X	A	1	1, 5	R/W
			02	Primary side current of CT	XXXX	A	2	1 to 4000	R/W
			03	VT ratio	XXX.XX	—	3	100 to 60000	R/W
			09	Conversion rate (P)	XX.XX	—	2	0 to 9999	R/W
			0F	Conversion rate (-P)	XX.XX	—	2	0 to 9999	R/W
04	05	03	00	Auto-off	XX	min	1	0 to 99 (0: always ON)	R/W
			01	Luminance	X	—	1	1 to 5	R/W
			02	Auto display start	XX	min	1	0 to 99 (0: fix display item)	R/W
			03	Display cycle	XX	min	1	1 to 99	R/W
			04	Temperature correction value	XXX.X	℃	2	-100.0 to 100.0	R/W
00	01	00	00	Total integral active power	XXXXXX.XX	kWh	4	0 to 999999.99	R
	15			Integral active power (1)	XXXXXX.XX	kWh	4	0 to 999999.99	R
	29			Integral active power (2)	XXXXXX.XX	kWh	4	0 to 999999.99	R
	3D			Integral active power (3)	XXXXXX.XX	kWh	4	0 to 999999.99	R
00	0B	00	00	Total integral reactive power	XXXXXX.XX	kvarh	4	0 to 999999.99	R
	1F			Integral reactive power (1)	XXXXXX.XX	kvarh	4	0 to 999999.99	R
	33			Integral reactive power (2)	XXXXXX.XX	kvarh	4	0 to 999999.99	R
	47			Integral reactive power (3)	XXXXXX.XX	kvarh	4	0 to 999999.99	R
00	09	00	00	Total integral apparent power	XXXXXX.XX	kVAh	4	0 to 999999.99	R
	1D			integral apparent power (1)	XXXXXX.XX	kVAh	4	0 to 999999.99	R
	31			integral apparent power (2)	XXXXXX.XX	kVAh	4	0 to 999999.99	R
	45			integral apparent power (3)	XXXXXX.XX	kVAh	4	0 to 999999.99	R
00	02	00	00	Total integral export active power	XXXXXX.XX	kWh	4	0 to 999999.99	R
	16			Integral export active power (1)	XXXXXX.XX	kWh	4	0 to 999999.99	R
	2A			Integral export active power (2)	XXXXXX.XX	kWh	4	0 to 999999.99	R
	3E			Integral export active power (3)	XXXXXX.XX	kWh	4	0 to 999999.99	R
00	0C	00	00	Total integral export reactive power	XXXXXX.XX	kvarh	4	0 to 999999.99	R
	20			Integral export reactive power (1)	XXXXXX.XX	kvarh	4	0 to 999999.99	R
	34			Integral export reactive power (2)	XXXXXX.XX	kvarh	4	0 to 999999.99	R
	48			Integral export reactive power (3)	XXXXXX.XX	kvarh	4	0 to 999999.99	R
02	03	00	00	Total instantaneous active power	XX.XXXX	kW	3	-79.999 to 79.999	R
		01		Instantaneous active power (1)	XX.XXXX	kW	3	-79.999 to 79.999	R
		02		Instantaneous active power (2)	XX.XXXX	kW	3	-79.999 to 79.999	R
		03		Instantaneous active power (3)	XX.XXXX	kW	3	-79.999 to 79.999	R
		FF		Instantaneous active power data block			12		

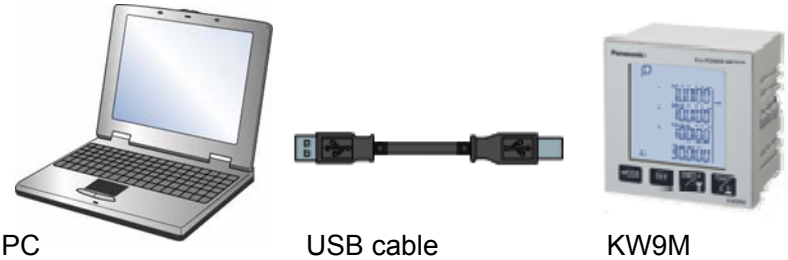
Data identification				Name	Data format	unit	byte	range	R/W
DI_3	DI_2	DI_1	DI_0						
02	04	00	00	Total instantaneous reactive power	XX.XXXX	kvar	3	-79.999 to 79.999	R
		01		Instantaneous reactive power (1)	XX.XXXX	kvar	3	-79.999 to 79.999	R
		02		Instantaneous reactive power (2)	XX.XXXX	kvar	3	-79.999 to 79.999	R
		03		Instantaneous reactive power (3)	XX.XXXX	kvar	3	-79.999 to 79.999	R
		FF		Instantaneous reactive power data block			12		R
02	05	00	00	Total instantaneous apparent power	XX.XXXX	KVA	3	0 to 99.9999	R
		01		Instantaneous apparent power (1)	XX.XXXX	KVA	3	0 to 99.9999	R
		02		Instantaneous apparent power (2)	XX.XXXX	KVA	3	0 to 99.9999	R
		03		Instantaneous apparent power (3)	XX.XXXX	KVA	3	0 to 99.9999	R
		FF		Instantaneous apparent power data block			12		R
02	01	01	00	Voltage 1	XXX.X	V	2	0 to 999.9	R
		02		Voltage 2	XXX.X	V	2	0 to 999.9	R
		03		Voltage 3	XXX.X	V	2	0 to 999.9	R
		FF		Voltage data block			6		R
02	0C	01	00	Line voltage 1-2	XXX.X	V	2	0 to 999.9	R
		02		Line voltage 2-3	XXX.X	V	2	0 to 999.9	R
		03		Line voltage 3-1	XXX.X	V	2	0 to 999.9	R
		FF		Line voltage data block			6		R
02	02	01	00	Current 1	XXX.XXX	A	3	0 to 999.999	R
		02		Current 2	XXX.XXX	A	3	0 to 999.999	R
		03		Current 3	XXX.XXX	A	3	0 to 999.999	R
		FF		Current data block			9		R
02	06	00	00	Power factor (average)	X.XXX		2	-1.000 to 1.000	R
		01		Power factor 1	X.XXX		2	-1.000 to 1.000	R
		02		Power factor 2	X.XXX		2	-1.000 to 1.000	R
		03		Power factor 3	X.XXX		2	-1.000 to 1.000	R
		FF		Power factor data block			8		R
02	80	00	02	Frequency (average)	XX.XX	Hz	2	0 to 99.99	R
			07	Temperature	XX.X	℃	2	-99.9 to 99.9	R

*For signed data, the upper bit shows the sign. ‘0’ shows plus and ‘1’ shows minus.

6.6 How to install USB driver

It is necessary to install USB driver (kw9musb_vxxx.inf) for connecting KW9M Eco-POWER METER via USB communication.
* Once installing USB driver, it is not necessary to install from the second time.
* When you change the using port, install the driver again.

Turn on KW9M and connect KW9M and PC via USB cable.
After that, install USB driver according to your OS.



PC USB cable KW9M

Chapter 7 Specifications

7.1 Main unit

Supply voltage range	85 to 264V AC 100 to 300V DC		
Rated frequency	50/60Hz		
Nominal power consumption	Approx. 5VA (240V AC at 25℃) Approx. 3W (240V DC at 25℃)		
Inrush current	30A or less (240V AC/DC at 25℃)		
Allowable momentary power-off time	10ms		
Ambient temperature	Accuracy guarantee	-10 to + 55℃	
	Operation	-25 to + 55℃	
	Storage	-25 to + 70℃	
Ambient humidity	30 to 85%RH (at 20℃) non-condensing		
Breakdown voltage (initial)	Between the isolated circuits: 2000V/1min	a) enclosure ⇔ all terminals b) between insulated circuits ・power supply terminals ⇔other terminals ・RS485 terminals ⇔other terminals ・measured current input terminals ⇔ other terminals	
Insulation resistance (initial)	Between the isolated circuits: 100 MΩ or more		
Vibration resistance	10 to 150Hz (7.5 minutes/cycle) single amplitude:0.075mm (1h on 3 axes)		
	10 to 55Hz (1 minute/cycle) single amplitude:0.375mm (1h on 3 axes)		
Shock resistance	Min. 294m/s^2 (5 times on 3 axes)		
Display method	LCD with backlight		
Power failure memory method	Internal memory (overwrite 10^{10} or more)		
Degree of protection	Front: IP51 Back: IP20		
Sea level altitude	Under 2,000m		
Dimensions W/H/D	96 x 96 x 56 mm (without terminal block) 96 x 96 x 68 mm (with terminal block)		
Weight	Approx. 450g		
Terminal connection	Cable conductor cross section		
	Single wire 1pc.	0.13 to 4mm^2 (AWG26 to 12)	
	Stranded cable 1pc.	0.2 to 4mm^2 (AWG24 to 12)	
	Single wire/ stranded cable 2pcs.	0.5 to 2.1mm^2 (AWG20 to 14)	
	Stripping length	7-8mm	
	Connection method	Screw M2.5	
	Tightening torque	0.4 to 0.5 N m	

7.2 Input Specifications

Measured data		AC sine		
Phase/wire system		Single-phase two-wire (1P2W) (max.3-circuit) Single-phase three-wire (1P3W) Three-phase three wire (3P3W) Three-phase four-wire (3P4W)		(common)
Applicable power system		100V system, 200V system, 400V system		
Measured frequency		50/60Hz		
Sampling rate		Sampling	1.024MHz (approx.1.0 μs)	
		Data update	100ms	
Voltage	Input voltage	1P2W	L-L	0-500V AC
		1P3W	L-L	0-500V AC
			L-N	0-250V AC
		3P3W	L-L	0-500V AC
		3P4W	L-N	0-500V AC
			L-L	0-289V AC
	Impedance	2 MΩ or more (L-N; V1/V2/V3 - Vn)		
	Resolution	0.01V		
	Power consumption	Approx. 0.2VA (L-N; V1/V2/V3 - Vn)		
	Accuracy *1	0.5% *1.0% for 3-1 voltage of 1P3W, 3P3W and line voltage of 3P4W.		
	VT ratio	1.00 to 600.00 (set with setting mode) *Voltage transformer (VT) is required when you measure a load with voltage over rated voltage. (Rated secondary voltage of VT is 110V.) *When it input direct, VT ratio is set to 1.00.		
Current	Input current (with CT)	Primary current	4000A or less	
		Secondary current	1A or 5A (set with setting mode)	
	Max. current	10A (200% of the rating)		
	Overload capacity	1000% of the rating for 3s		
	Resolution	0.001A		
	Power consumption	Approx. 0.2VA		
	Accuracy *1	0.5% *1.0% for 2(N)-phase of 1P3W and 2(S)-phase of 3P3W.		
Power	Accuracy *1	1.0% Active power Class 1 (IEC 62053-21) Reactive power Class 2 (IEC 62053-23)		
Tempera-ture	Accuracy	±5.0℃ (after ambient temperature correction with setting mode) Passing 2 hours or more after energized		

*1 Without error of current transformers (CT) and voltage transformers (VT)
・It measures from 0.1% of CT secondary current.

7.3 Communication Specifications

<RS485>

Interface		Conforming to RS485
Communication method		Half-duplex
Synchronous system		Synchronous communication method
Isolation status		Isolated with the internal circuits
Protocol		MEWTOCOL, MODBUS(RTU), DL/T645-2007 *1 (select with setting mode)
Number of connected unit		99 (max.) *2
Transmission distance		1200m *3
Transmission speed		38400, 19200, 9600, 4800, 2400, 1200bps (select with setting mode)
Transmission format	Data length	8bit (fixed)
	Parity	Not available / odd number / even number (select with setting mode)
	Stop bit	1bit, 2bit (select with setting mode)

*1 MEWTOCOL is the protocol for PLC from Panasonic.
DL/T645 is the China power-meter standard. Only DL/T645-2007 is supported.

*2 For RS485 converter on the computer side, we recommend SI-35 and SI-35USB (from LINE EYE Co.,Ltd.). When using SI-35,SI-35USB or PLC from our company (which can be connected up to 99 units), up to 99 can be connected. In case using this system with the other devices, up to 31 can be connected.

*3 Please check with the actual devices when some commercial devices with RS485 interface are connected. The number of connected devices, transmission distance, and transmission speed may be different according to using transmission line.

< USB >

Electric specification	Conform to USB2.0 standard
Connector shape	USB series MiniB
Insulation method	Insulated to internal circuit
Transmission speed	12Mbps(Full-Speed)
Transmission function	Computer link (MEWTOCOL)

*Install the dedicated USB driver before using USB port.

7.4 Self-diagnostic function

If an error occurs, the following indication will be given.
When several errors occur, [1] are indicated for the designated digits.

Indicator	Meaning	To recover	After recovery
00000001	Hardware breakdown	Change main unit due to the end of hardware	
00000100	Firmware update failure	Update again	Start with updating firmware.
00100000	Internal program error	Power on again	Before the abnormal
10000000	Memory breakdown or crash *	Change main unit due to the end of internal memory	

*Includes the possibility that the internal memory life has expired.

7.5 Power Failure Memory

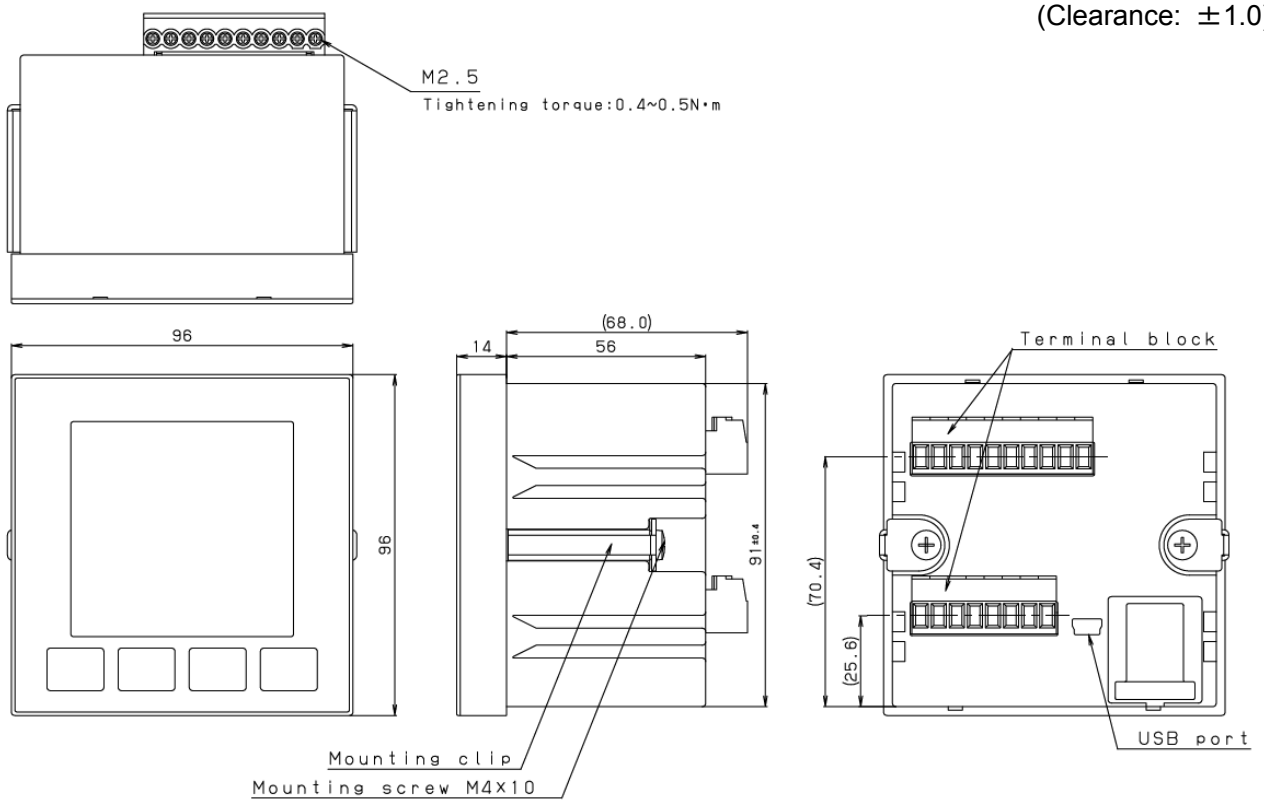
Eco-POWER METER memories integrated electric power and working status to internal memory until when power supply is off. (Power failure guarantee)
And every time to change each setting, each setting value is memorized to internal memory at the same time. Rewritable times are limited. Especially be careful if you set by communication.

Chapter 8 Mounting

8.1 Dimensions

8.1.1 Main unit

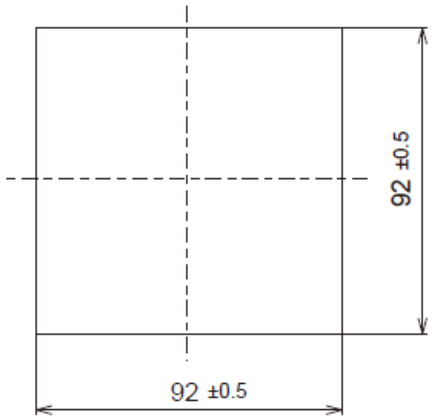
(Unit: mm)
(Clearance: ±1.0)



8.2 Panel mounting

(Unit: mm)

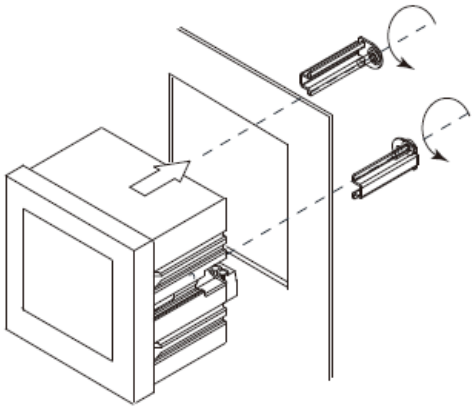
◆Panel cut-out



Keep enough space for several mountings.
recommended space:
130mm the left, right, top and bottom
from center of the unit

◆Panel mounting

1) Remove the mounting clips from the unit.
2) Insert the unit from the front of the panel.
3) Attach the mounting clips at the both side of the case and secure in place with the screws.
(Tightening torque: approx. 0.2 to 0.3N·m)
·Applicable panel thickness: 1 to 5mm



<Indication on KW9M Eco-POWER METER>
The alphabet is shown as below.

	A	B	C	D	E	F	G	H	I	J	K
Value display											
Item indicator Top left											

	L	M	N	O	P	Q	R	S	T	U	V
Value display											
Item indicator Top left											

	W	X	Y	Z
Value display				
Item indicator Top left				

Revision History

Issue Date	Manual No.	Content of revision
November, 2012	WUME-KW9M-01	First edition

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Specifications are subject to change without notice.

WUME-KW9M-01